

DISCUSSION PAPER SERIES

DP15292
(v. 2)

BOMBS, BROADCASTS AND RESISTANCE: ALLIED INTERVENTION AND DOMESTIC OPPOSITION TO THE NAZI REGIME DURING WORLD WAR II

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ECONOMIC HISTORY



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Discussion Paper DP15292
First Published 14 September 2020
This Revision 20 November 2020

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www.cepr.org

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Abstract

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JEL Classification: N/A

Keywords: resistance, Nazi regime, bombing, radio propaganda

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Bombs, Broadcasts and Resistance: Allied Intervention and Domestic Opposition to the Nazi Regime during World War II

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November 2020

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Keywords: Media, BBC, bombing, resistance, WWII

JEL Classification: D74, L82, N44

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1. Introduction

Is the word mightier than the sword? In most conflicts, adversaries aim for victory by both direct force and indirectly, by undermining the enemy's will to resist. Rapid, easy victories often rely as much on military might as on destroying the enemy's morale (Hastings 2011; Horne 2012). Two tools are often used in a bid to weaken the enemy's will: "shock and awe" - impressive shows of strength - and propaganda. Air power advocates have long argued that bombing can weaken support for a regime, undermining the enemy's morale while boosting internal dissent (Douhet 1921).¹ Some argue that the atomic bombing of Japan hastened the end of the war (Hastings 2011).¹ Similarly, propaganda is often used by foreign powers during wartime to undermine morale and promote resistance (Somerville 2012).

There is widespread skepticism about the efficacy of both aerial attack and foreign propaganda: US bombing in Vietnam boosted Communist insurgents' popularity (Dell and Querubin 2018); the "Blitz" – Germany's bombing of London in 1940 – may have increased support for the UK government (Hastings 2013, 458). Because German armament production and civilian morale did not collapse, the Allied bomber offensive during World War II against Germany is widely considered a failure (Overy 2013; Pape 1996).² Similarly, (Pütter 1997) suggests that allied radio programs did little to win German hearts and minds. Generally, there is substantial skepticism about the effectiveness of foreign media campaigns because people will not trust “the enemy” (Martinez-Bravo 2019; Mannheim 1986; Pieslak 2009).

In this paper, we examine the effects of bombing and radio propaganda on domestic opposition and morale during World War II. We do so for the Allied air offensive against Germany in World War II—the second-largest bombing campaign in history.³ Between 1939 and 1945, British and American bombers dropped more than two million tons of TNT⁴ in Europe alone, the equivalent of more than 100 of the nuclear bombs that destroyed Hiroshima and Nagasaki. The air war was costly for all combatants: The UK devoted one third of

¹ The claim is disputed by some other scholars (Wilson 2007).

² John K. Galbraith called it "... the greatest miscalculation of the war." Galbraith acted as one of the civilian directors of the US Strategic Bombing Survey, tasked with evaluating the effects of the air war. One leading historian, Richard Overy (2013) went as far as to argue that, “the effect of bombing was not, as the Allies hoped, to drive a wedge between people and regime, but the opposite...”

³ The bombing of Vietnam involved higher tonnages dropped, but fewer aircrafts.

⁴ The explosive power of different explosives is, by convention, measured in tons of TNT (specifically, 2,4,6-trinitrotoluene)—a unit of energy that equals 4.184 gigajoules.

wartime production to strategic bombing.⁵ Allied air attacks killed 360,000 Germans alone. Casualties among Allied aircrews outnumbered the number of service men killed in ground combat on the Western front: of the Royal Air Force (RAF) bomber crews 56,000 men died; the United States Army Air Force (USAAF) lost 20,000 men (Hastings 2013). We examine the impact of bombing and radio propaganda on two groups of Germans: those potentially critical of the regime, and those potentially favoring the regime, i.e. highly motivated military personnel. First, we show that bombing can increase the frequency of active resistance substantially—even against an overwhelmingly powerful, efficiently run, and deeply entrenched government (Evans 2008). Second, we demonstrate that bombing of the *Reich* had a pronounced, negative impact on the morale of German fighter pilots.

We begin by compiling new data on resistance against the Nazi regime in Germany during World War II. Information from treason trials provides details on the scale and seriousness of resistance activity.⁶ We focus on the years 1943–44—the period when the overwhelming share of bombing occurred, but before Germany’s final defeat was certain. This is also the period when the People’s Court, a high-level court staffed by determined Nazi judges, had exclusive jurisdiction over treason trials. Treasonable activity ranged from defeatist comments, distributing leaflets, and encouraging sabotage by foreign slave workers to the attempted assassination of Hitler and the overthrow of his government, including the famous von Stauffenberg plot of military officers in the summer of 1944.

For most of the war, Allied bombers flew from UK bases. German cities beyond the operational range of these planes were bombed much less—and they also saw fewer acts of resistance. Bombers’ limited operational range created a sharp discontinuity in bombing and resistance. Using a regression discontinuity approach, we first show that the drop in bombing beyond the range of the main bomber used by the Allies neatly coincides with a decline in resistance activity. Next, we analyze changes in the frequency of bombing and resistance activity over time, exploiting the panel nature of our data. Volatile weather conditions serve as an exogenous source of variation. We predict daily bombing from daily data on winds speeds over German cities during World War II. A doubling of bomb volume increased the number of resistance cases in our data by 4.8%, and the probability of resistance grew by 3.8%. Importantly, our results are not driven by a rise in policing after bombing raids.

⁵ O’Brien (2015) shows that half of German armament and munitions output was devoted to aircraft and anti-aircraft guns.

⁶ These data were first exploited in a quantitative fashion by Geerling, Magee, and Brooks (2013).

Allied bombing not only targeted civilians; it also aimed to undermine the German armed forces' will to resist. To study this channel, we analyze the performance of German fighter pilots during World War II. In aerial combat, individual motivation is key—asymmetric information abounds, and there is no effective control by superiors during an air battle (Ager et al. 2017). For 352 German pilots who scored more than 5 victories ('aces' who are in the top 7% of pilots), we collect data on their city of origin.⁷ Combining this information with the time of bombing and data on the number of aerial victories, we test whether aerial attack on pilots' hometowns undermined their combat effectiveness. We find sharp reductions in the frequency of monthly aerial victories: while pilots downed on average 1.9 Allied aircrafts per month, this rate declined by 10-30% after home-town bombings.

Importantly, the flames of resistance activity were fanned more effectively where Germans could listen to the BBC. For identification, we exploit quasi-exogenous variation in signal strength of the BBC. In the resistance data, we find that where news from London arrived together with Allied bombers, German resistance became markedly more likely. In terms of the magnitudes, with a one standard deviation increase in BBC availability, the Allies could have achieved the same effect on domestic opposition while reducing bombing by 25.3%.

Our main contribution is to document and quantify the impact of bombing and foreign radio on domestic opposition and morale during the deadliest military conflict in history. Our paper is related to Dell and Querubin (2018).⁸ They show that US bombing in Vietnam reduced support for the Southern Vietnamese government, while increasing popular backing for the Vietcong. There, villages were bombed by their *own* government's main ally. Our paper examines air attack by an enemy power intended to undermine citizens' backing for their own government. In both cases, the regime's failure to protect its citizenry resulted in less popular support. Our study sheds light on effective strategies against dictatorial governments, and it underlines the role of radio propaganda as a potential complement to bombing.

We further contribute to three distinct literatures—the effects of media on political attitudes, the determinants of regime support, and the history of the air war during World War II. There is a growing consensus that media exposure can change political attitudes and voting behavior. Work by Gentzkow and Shapiro (2010) argues that newspapers mostly cater to their consumers, and exert little effect on their audience's political views. Subsequent work has

⁷ By using the term "aces"—shorthand for high-performing pilots—we do by no means wish to glorify their deeds, which served to keep a genocidal regime in power.

found numerous examples when media exposure influenced voting behavior, including Fox News in the United States (DellaVigna and Kaplan 2007), NTV in Russia (Enikolopov, Petrova, and Zhuravskaya 2011), Berlusconi channels in Italy (Durante, Pinotti, and Tesei 2017). In addition, an emerging literature looks at the effect of radio on more extreme forms of behavior. Yanagizawa-Drott (2014) demonstrates that radio propaganda was an important driver of violence against the Tutsi minority in Rwanda. Relatedly, Gagliarducci et al. (2020) argue that the BBC helped to coordinate partisan activity in German-occupied Italy during WWII, leading to more reprisals. However, they find no effects on the motivation of Italians to oppose the fascist regime.⁸ At the same time, Armand and Gomes (2020) document that radio can help to mitigate civil conflict in Uganda. Our paper contributes to this literature by showing that propaganda can be effective—even in the extreme case of encouraging resistance against one’s own government during a war with a foreign power.

We also contribute to the literature on autocracies and their public support. Classic treatments like Arendt (1973) as well as Acemoglu and Robinson (2000) emphasize potential conflict between a small elite and the populace at large. Recent research has increasingly emphasized that dictatorships endure by co-opting one part of the population while repressing another (Gandhi and Przeworski 2006; 2007; Wintrobe 1998). Guriev and Treisman (2019) argue that propaganda and misinformation are common tools for dictators to ensure public support. Adena et al. (2015) show that German radio promoted electoral support of the Nazis and encouraged violence against Jews in late 30s.⁹ Also, people who have experienced state repression seem to reduce their support of authoritarian governments (Iwanowsky and Madestam 2019, Bautista et al. 2020). While some historians have emphasized the Nazi regime’s popularity as a result of plunder and exploitation after 1939, others underline the importance of totalitarian surveillance and repression, ranging from local party representatives to the secret police (Gestapo) and concentration camps (Evans 2008; Aly 2005). Our paper furthers this literature by examining the role of military destruction and foreign propaganda on the support for an autocracy at war.

By examining the efficacy of bombing, we also relate to the economic history of war. Many historians have questioned the effects of bombing. Allied victory in World War II is mainly

⁸ One potential explanation is that Italy had relatively few listeners—there were less than 1 million of radio sets in 1938 (Briggs 1995) and 1.02 million in 1944 (Laden 2018).

⁹ We cannot survey the vast literature on the rise of the Nazi party here. Among recent contributions, Spenkuch and Tillmann (2018) argue that religion played an important role in ensuring Nazi party support. Satyanath et al. (2017) argue that social capital facilitated transmission of Nazi beliefs before 1933.

attributed to the Western powers' economic superiority and the Red Army's sacrifices on the battlefield (Harrison 1998; Beevor 2012; Hastings 2011). Following skepticism by the one of the chief authors of the Strategic Bombing Survey's, the economist John K. Galbraith, several historians have emphasized that German industrial production continued to surge under the hail of bombs unleashed by Western Allies—and that the population did not turn against the Nazi government. Both Hastings (2013) and Overy (2014) argue that the effects on morale were disappointing from the perspective of the US and UK air forces, and that armament production was not affected significantly. In contrast, O'Brien (2015) argues that the logistical demands of both sea and air battle undermined Germany's war effort. Along similar lines, some scholars see an important role of the bomber offensive in undermining the *Luftwaffe*'s fighting strength (Keeney 1988). There is no agreement about the effect of air power on the morale of the German armed forces. The *Wehrmacht* fought hard until the very end of the war, despite heavy bombardment at home and on the front (Kershaw 2016). Therefore, it appears that devastation at the home front failed to undermine the troops' fighting spirit (Hastings 1981).

To sum up, we make the following contributions to the existing literature: we show that bombing had important effects, generating domestic opposition while depressing servicemen's morale. This is in line with the main aim of aerial bombardment in World War II, which was to increase opposition against the Nazi regime (Overy 2014). Second, we find a synergistic effect with radio propaganda. This is important because there is, until now, no empirical study on the topic.¹⁰ Both the BBC and the UK government believed in the effectiveness of its German service; media historians have doubted its effect (Pütter 1986, 26). Our findings show that bombing and broadcasts in combination were particularly effective in creating opposition, while the effect of radio alone was rather limited.

The rest of the paper is organized as follows. Section 2 provides historical background. Section 3 describes the data. Section 4 summarizes the results for bombing. Section 5 provides further evidence on the impact of radio propaganda and its interaction with bombing. Section 6 concludes.

¹⁰ The related paper by Gagliarducci et al. (2020) examines radio as a means to coordinate partisan activity, not a tool to instigate opposition.

2. Historical Background

In this section, we summarize key aspects of the historical background—the history of aerial bombardment and its effect on production and civilian morale, BBC radio propaganda, and combat motivation in the German armed forces.

The military use of air power

After World War I, many strategists believed that future conflicts could be won by air power alone.¹¹ According to this view, future wars would involve the massive use of aerial bombardment against civilian populations: “the man in the street [should] realize that there is no power on earth that can protect him from being bombed... *the bomber will always get through*. The only defense is in offence, which means [to] kill more women and children more quickly than the enemy...*Stanley Baldwin, Prime Minister*” (emphasis added, Hastings 2013). The German bombing of Guernica during the Spanish civil war added urgency to these predictions. By the autumn of 1940, after failing to win air superiority, the German air force began to bomb London, Coventry, and other British large cities. The Royal Air Force in turn attacked Berlin and other German cities. The RAF’s Bomber Command received a high share of available resources, reaching a maximum of almost 2,000 operational planes by the end of the war. Bomber Command flew more than 300,000 sorties against Germany resulting in a loss of around 8,000 aircraft and 55,000 air crew killed (Davis 2006).

Once the US joined the Allied war effort, the strategic bombing of German industry and cities intensified.¹² By the end of the war, the 8th and 15th US Air Forces in Europe each employed more than 150,000 men and could field up to 1,000 bombers plus 800 escort fighters. USAAF lost 20,000 men over Europe, flying 410,000 missions. In combination, the US and UK air forces dropped more than 2 million tons of bombs during the period 1942 to May 1945, losing some 14,000 aircraft in the process (Davis 2006).¹³

The US initially emphasized precision bombing. Because of poor weather conditions in Europe¹⁴ and fierce German defense,¹⁵ the USAAF eventually switched to area attacks.

¹¹ The Italian general Giulio Douhet was the most prominent proponent of this view, publishing a book (in Italian) entitled *Command of the Air* (Douhet 1921)

¹² The US was unique in having a four-engined bomber in production when World War II began, the B-17 “Flying Fortress.” In the UK, such aircraft were still on the drawing board; in Germany, they would mostly remain there for the rest of the conflict.

¹³ Of these, 1.2 million tons were dropped on Germany.

¹⁴ On Sept. 6, 1943, the 8th US Air Force sent a force of 338 bombers to attack Stuttgart. Only 262 planes made it to Germany; out of these, only 46 attacked Stuttgart because of dense cloud over the city. The other planes diverted to alternative targets including Karlsruhe and Offenburg, about 100 km away.

Ultimately, it devoted twice as many bombs to attacking city areas as to ‘precision bombing’ (Ross 2003). As the German air force declined in strength, Allied bombing accelerated—more than three quarters of all tonnage was dropped in the last 12 months of the war (Overy 2014).

Bombing’s military and industrial consequences

The main military effect of strategic bombing was to divert artillery and German fighter aircraft to the “home front” (Hastings 2013). By the end of the war, 12,000 heavy guns and more than 400,000 men and women were employed in flak units all over Germany (Hastings 2013). More than half of Germany’s front-line fighters were sent back to defend the Reich against air attack. Fighting the RAF and USAAF in the skies over Germany devastated the Luftwaffe, leading to an accelerating decline of air support for her armies (Keeney 1988).

Attacks on the oil industry and on rail transport after the summer of 1944 made troop movement increasingly difficult, and hampered training (Overy 2014).¹⁶ The effect of bombing on armament production is harder to assess. Immediately after the end of the war, the United States conducted a detailed survey, the United States Strategic Bombing Survey (USSBS). It employed over 1,100 officers and civilian experts, including John Kenneth Galbraith. The study found that German armament production numbers had surged during the war. German output of aircraft, tanks, and guns only peaked in the second half of 1944, when the intensity of bombing reached its highest level. The USSBS conducted numerous detailed, plant-level analyses. There were several cases of significant reductions of actual production, but these were typically short-lived. Clearly, area bombardment was ineffective in reducing production. The great attack on Hamburg in July 1943 destroyed over 300,000 dwellings and killed 40,000—and yet, only the equivalent of 1.8 months of industrial production were lost as a result. Albert Speer, the German Minister of Armaments and War Production, predicted at first that production would collapse if the Hamburg attack was repeated six more times—but was astonished to see how quickly output recovered (Hastings 2013). The British bombing survey estimated that area attacks never reduced German production by more than 7%, and that its effect was possibly as low as 1% as late as 1944 (Overy 2014).

¹⁵ In the famous raids on the Schweinfurt ball bearing factories in October 1943, the USAAF used 376 B-17s. Of these, 147 were shot down. In a second raid, 60 USAAF aircrafts were destroyed and 142 were damaged, out of 291 employed.

¹⁶ Many of the planes, tanks, and artillery pieces produced during Speer’s “armament miracle” in 1943 and 1944 never reached the front line because of the rail network’s collapse. Once these weapons were in the *Wehrmacht*’s hands, many had to be abandoned for lack of fuel, also made a priority target in 1944 (Beever 2016).

Bombing and civilian morale

Pre-war strategists had envisaged air power as a war-winning weapon because of its expected effect on morale. Next to the goal of reducing military production, both the German bombing of Britain, and the Allied bomber offensive against Germany, were designed to destroy the population's will to resist. This is especially true of the RAF's strategy of nighttime attacks on German population centers.

Regular, massive bombing raids on Berlin during the RAF's "Battle of Berlin" (1943–44) seemingly undermined the regime's prestige. At the start of the war, Hermann Göring, the head of the German air force, had boasted that if a single bomb were to fall on Berlin, people could start calling him Meier. Throughout the later years of the war, Berliners commonly referred to air raid sirens as "Meier's trumpets" (Hastings 2013). Massive raids undermined beliefs in final victory. Hermann Göring himself, while witnessing B-17s over Berlin in early 1944, told a confidante that Germany had had lost the war (Overy 2014).

Numerous Germans resisted the Nazi regime, but—apart from the military plotters on July 20th, 1944—never got close to actually seizing power. There was no mass uprising and no collapse at the front during the Second World War, as there had been in 1918. This failure to destroy the Germans' will to resist is often seen as proof that Allied strategic bombing was fundamentally flawed.¹⁷ At the same time, anecdotal evidence shows that support for the regime was heavily dented by the devastation of German cities. After the fire bombing of Hamburg in July 1943, the German security services reported that across the Reich, all "feeling of security" had collapsed (Stargardt 2015). Indeed, for several months after the Hamburg raid, Gestapo reports point to a generalized belief that the war was lost, and that the Nazi leadership had to go—as happened to Mussolini in Italy at the same time. While the acute crisis in 1943 passed, aerial attacks dented the belief in victory: Open criticism of the war and the regime became common-place, Nazi party members were set upon in the streets, and open contempt for the air force leadership became common (Evans 2008). The fact that bombing did not lead to mass opposition against the regime may therefore tell us more about the repressive powers of the government than the failure of strategic bombing to undermine morale.

¹⁷ Major Alexander Seversky, of the **USAAF**, concluded in 1942 that "it had been generally assumed that aerial bombardment would quite quickly shatter popular morale ... it now seems clear that despite large casualties and impressive physical destruction, civilians can "take it." On the whole, indeed, armed forces have been more quickly demoralised by air power than unarmed city dwellers." (Hastings 2015, p. 458).

BBC German services and radio technology

Germany was a country of radio listeners—there were 9 million registered receivers by 1938, growing to over 16 million in 1943 (see figure F.1 in Appendix F). Some estimates indicate that by January 1938, half of all households possessed a *Volksempfänger* (people's receiver).¹⁸ This also meant that Germans could and did listen in large numbers to foreign radio, the BBC in particular, despite the fact that this activity was strictly prohibited by the government. According to Briggs (1995, p.11) the BBC “did more than any comparable agency both to pull together different elements of resistance in each separate European country - by giving news... by providing ideas and inspiration and at certain stages by passing on operational orders—and to spread relevant information between countries.”

In contrast to German and Soviet propaganda, the BBC maintained a high standard of journalistic probity. Its broadcasts included timely and accurate information about the course of the war. This included open admissions of defeats and failures, such as the fall of Dunkirk, which enhanced the BBC credibility with German listeners (Somerville 2012). BBC programming also aimed to uncover German propaganda lies in a bid to undermine support for the Hitler government, and included popular items such as messages from German prisoners of war. Programming focused on exposing Nazi lies and propaganda.

The BBC recruited prominent speakers such as the writer and Nobel laureate Thomas Mann. Mann addressed the bombing in his radio broadcasts:

“Hitler is boasting that his Reich is ready for ten, even twenty years of war. I assume that you Germans have your own ideas about that—for example, that after a fraction of this time no stone will stand on top of another in Germany.”¹⁹

Overall, during the war, the BBC (1944) felt that “Germans listen to London and take seriously what they hear.” Over time, more and more Germans turned to it as a reliable source of information (Evans 2008, p.576). There was an important synergy between radio propaganda and the air war. In the words of the Morale Division's report in the USSBS, “Black [illegal] radio listening and disbelief in official propaganda increased steadily during the last 2 years of the war... Bombing had much to do with the final discrediting of propaganda and of the Nazis because it brought home to millions the tangible proof of almost

¹⁸ Plock (2020).

¹⁹ Translation from English version edition: Mann, Thomas (1943), *Listen, Germany!*.

unopposed Allied air power, indisputable proof completely at variance with familiar Nazi propaganda...”

In Germany, listening to “Radio London” (and many other foreign broadcasts) was strictly prohibited. Every radio receiver came with official stickers warning listeners of severe penalties for anyone tuning in to foreign stations. Violating the ban on listening to enemy stations was punishable by imprisonment or, in case of additional spreading of foreign propaganda, by death. To block the BBC reception, a number of jamming transmitters were installed, but they were apparently largely ineffective (Klingler 1983, p.56). Despite prohibitions and penalties, anecdotal evidence suggests that many Germans tuned in secretly to the BBC. While accurate estimates are impossible to obtain, the Gestapo estimated the number of listeners to the London Christmas program in 1941 at around 1 million (Klingler 1983). By 1944, the BBC guessed that 10-15 million Germans were listening (Kaufmann 2013).

From its start in 1938, the BBC German Service broadcast on medium wave frequencies, using transmitters in south-east England. Short wave technology was well-developed by the 1930s, but the number of compatible German receivers was kept low on purpose; owners were placed under observation. Those who purchased parts to build powerful receivers were routinely reported to the Gestapo (Weidenhaupt 2001, p.56). The people’s receiver, the most popular radio set in wartime Germany, did not offer short-wave reception. Both the main German radio program as well as the BBC German Services were transmitted on medium wave.

Therefore, we confine our attention to medium wave transmissions. As one media historian argued:

“The German broadcast of the BBC was the first and for a long time the only program for the Reich which could be transmitted via medium-wave and which was strong enough to reach the famous “man in the street” in the first place.” (Pütter 1978, p.127).

To identify the effect of the BBC we rely on the exogeneity of radio reception. The quality of the BBC signal was largely determined by distances to transmitters and topography. The impact of geography on radio reception allows us to exploit variation over relatively small geographical areas.

Resistance

Resistance against the regime took a variety of forms. Even trivial offences such as jokes about the party and leadership were officially considered treasonous. More serious were comments about the course of the war and the possibility that Germany might lose, or anti-regime graffiti and the circulation of flyers—a crime against the people’s will to resist, in Nazi parlance, a crime punishable by death. Even more important were attempts to sabotage the war effort, aiding the escape of prisoners of war, and the like. The most serious form of resistance were attempts at violent overthrow of the government. Our data covers the entire range of opposition activities, and includes the conspirators of the July 1944 plot to kill Hitler and overthrow the regime.

Soon after the Nazis came to power, they put in place a powerful secret police, the Gestapo, to stamp out subversive activities. Under the overall control of Heinrich Himmler and the SS, the internal security apparatus quickly won the war on crime and reduced all organized opposition networks to impotence (Evans 2005). By the late 1930s, there was almost no scope for internal resistance. Only after the start of World War II did some measure of resistance activity reemerge, often centered on working class neighborhoods where the Communists had polled strongly before 1933.

Widespread skepticism about the effectiveness of air power and propaganda can be rationalized by the fact there was no mass uprising against Nazi rule, and that no attempt to overturn the regime was successful. At the same time, Hitler was the subject of no fewer than 42 documented assassination attempts – possibly a world record (Berthold 1997).

Morale in the German military

The fighting spirit of Germany’s armies was relatively high during much of the war (Van Creveld 2007). Nonetheless, bombing of the home front seemingly undermined military morale. Soldiers on home leave witnessed the destruction of their hometowns and experienced air raids. Others received news from their families:

“With the increasing bombing attacks on German towns, and the heavy civilian losses, the morale of troops is badly affected. Every day, soldiers receive news of the destruction of their homes, the tragic death of wives and children. They return from leave depressed.” (Hastings 1981).

In 1944, Berliners joked that volunteers for the Eastern front had to be cowards, because life was less dangerous there than at home. For airmen in particular, the destruction of German

cities was a severe blow to their status: every bomb that landed on German soil demonstrated the *Luftwaffe*'s weakness (Evans 2008).

3. Data

In this section, we briefly describe our data sources and discuss basic patterns. Note that summary statistics for key variables used in the analysis are shown in Table A.1 in the Appendix A. More details on data sources can be found in Appendix G.

Resistance. To measure resistance, we digitize high treason court cases held during the years 1943 and 1944. This yields data on almost 2,000 accused individuals who stood trial before the People's Court. This court was established in 1934 outside the normal legal structure, after the German Supreme Court had offended the Hitler government by acquitting all but one of the defendants in the famous Reichstag fire case. Charged with prosecuting political crimes and staffed by hand-picked Nazi judges, it handed down a large number of death sentences during the war (Geerling, Magee, and Brooks 2013; Geerling et al. 2018).

All cases in our dataset concern political opposition. Defendants include members of the "White Rose" resistance movement—the group of Munich students around Hans and Sophie Scholl—as well as some of the conspirators of the July 20, 1944 plot. In the sample there are at least 53 individuals accused of planning, assisting, or executing 5 distinct plots to assassinate Hitler. Overwhelmingly, however, the accused are ordinary citizens whose trials (and frequently, death) left little trace in the public consciousness. Charges include undermining Germany war-making powers (*Wehrkraftzersetzung*), work slowdowns, defeatism, and treason.

For each of our court cases we collect information from the trial documents about the start of resistance, the time of arrest, place and type of resistance, and if there was any mentioning of radio listening. We find evidence of resistance in 532 distinct locations in 1943 and 192 in 1944. Because of the lag between the start of resistance activity and arrest (and further delays until the case was brought to trial) there are effectively no cases that began in 1945. We exclude the ones we find in the records.²⁰ Our main variable—new resistance—is measured monthly at the city level.²¹ We show the location of the resistance cases on the map in Figure

²⁰ Indeed, there is only one such case in 1945: resistance in Stettin. The court itself was hit hard by the bombing of Berlin in March 1945, when its head judge, Roland Freisler, was killed in a USAAF raid.

²¹ We aggregate resistance cases at the monthly level since in many instances the exact date of the start of resistance is somewhat vague.

1. Resistance took place all over the Germany.²² The timing of the resistance and the distribution of time between the beginning of resistance and the date of arrest are summarized in Figure 2.

Bombing. We use detailed information on the tonnage of bombs dropped on all German locations, based on (Davis 2006). In our regression discontinuity design analysis, we use both the intensive and extensive margin of bombing. In panel analysis, we exclude places with no bombing in either 1943 or 1944, to avoid making an inference based on locations that were never bombed. We depict the location and intensity of bombing on the map in Figure 3. Note that we only include locations inside Germany in its pre-1938 borders in our main data sample. The circle shows the maximum range for bombers flying from East Anglia.²³ The histogram in Figure A.2 also shows that although Allied bombing began in 1941, it intensified in 1943–1945.

Sample. We perform analyses at two different levels. Our main results are based on the sample of German cities, and some of our results are based on the sample of districts (*Kreise*). The city sample consists of 936 places. It includes all cities over 20,000 inhabitants plus other places being bombed plus places of resistance (place of living). For small places next to each other (or next to a larger city), a rule of thumb of 5 km (straight line) is used to merge them together (or to a larger city). For example Rheinhausen, Rheinhausen/Krupps, Duisburg/Rheinhausen, Friemersheim, Ruhrort, Meiderich are all merged with Duisburg. Places outside of the pre-1938 Reich boundaries²⁴ are dropped. Also places that are further than 120 km from the nearest weather station are dropped to ensure the reliability of weather data.

German Pilots. The data on fighter pilots come from the claim registry of the Oberkommando der *Luftwaffe* (Air Force High Command—OKL). The OKL fighter claims list was extracted by Jim Perry and Tony Wood from microfilms of the handwritten records of the *Luftwaffe* Personalamt stored at the German Federal Archives (*Bundesarchiv*) in Freiburg. This data is supplemented by information from the Kracker Archive. Because some OKL fighter claims records did not survive the war, Tony Wood augmented the list with claims

²² Some observations from other countries are deliberately not included in our main sample. Note that in our main regressions, we use the log transformation (+1) of resistance variables to avoid losing zeros.

²³ For simplicity, we use distances from Chelmsford, in East Anglia. The vast majority of allied bomber airfields were located in East Anglia (cf. Appendix A Figure A.1).

²⁴ See <https://web.archive.org/web/20170709100924/http://censusmosaic.org/data/historical-gis-files> for exact historical German boundaries.

from other published sources—such as Donald Caldwell’s (1996) JG26 war diary—to obtain a comprehensive list of German fighter claims for the years 1939–1945.²⁵

From these records, we take information for 352 high-scoring pilots whose place of birth is known. While we do not know whether pilots’ families still lived there, this is the only information on pilots’ home towns. Also, by focusing on high-performing pilots, we are measuring the impact amongst soldiers responsible for the vast majority of aerial ‘victories’—the top 5% of pilots accounted for one third of Allied aircraft shot down.

Other Socio-Economic Controls. We also use other district level socio-economic information from the 1925 and 1933 censuses, including shares of Jews and Catholics, blue- and white-collar workers, WWI participation, property tax, welfare recipients; political preferences in terms of voting in 1933; city status of the district; access to other sources of information: German radio signal strength, newspapers in the 1930s, and the number of cinemas.

USSBS Moral Division Survey. In addition, we assemble data from the post-war survey conducted by the United States Strategic Bombing Survey, Morale Division. Over 3,700 individuals were surveyed between March–July 1945 in 34 cities all over Germany, including seven never bombed cities, and excluding the Soviet zone of occupation. While earlier studies have only used the aggregated responses from the USSBS, we located all individual returns and digitized them. Amongst other items, the survey asked when and whether the person had started listening to Allied radio—around 50% of respondents answered in the affirmative. The survey also questioned people about when they thought the war was lost, and their views of the Nazi leadership, the reasons for losing the war, and people’s assessment of the post-war situation.

BBC Reception. In order to measure BBC reception in Germany, we collect information on BBC transmitters used to broadcast German services: their location (mainly in South-East England) and their power.²⁶ We predict BBC radio availability—the strength of radio signal, for 1943–1945 for every German locality, using information on the location and power of transmitters derived from the irregular terrain model (Hufford 2002; Olken 2009).

²⁵ For more information about Tony Wood’s combat claims list and the Kracker Luftwaffe Archive, see <https://web.archive.org/web/20130928070316/http://lesbutler.co.uk/claims/tonywood.htm> and <http://www.aircrewremembered.com/KrackerDatabase/>.

²⁶ There were no significant changes in the power over time in the time studied.

As is standard in the literature on radio's effects, we exploit information on actual listening as a function of reception quality. This yields an S-curve, with listenership declining rapidly below a threshold value of acceptable reception quality.²⁷ We unfortunately do not have systematic data on listenership to the BBC to estimate radio listening directly. Instead, we use self-reported listenership to the BBC from the USSBS to examine diffusion patterns. As Figure 4 suggests, people were able to listen to BBC with signal strength far below the conventional threshold, and we do not observe a flat tail on the left-hand side of the distribution (probably because people were willing to tolerate a noisy signal to obtain information). At the same time, the curve flattens out around the -8 threshold.²⁸ In what follows, we use the estimated relationship, as presented in Figure 4, to create a non-parametric function of signal strength to predict BBC listening.²⁹

Weather data. Weather data is available for 146 weather stations all over Germany at daily, 6-hourly, or hourly frequency for pre-war and war years (www.kachelmannwetter.com). We use data on wind speed for 1943–45. We interpolate this data for the sample of 936 towns and cities using a standard interpolation procedure (Pebesma 2004; Pebesma and Wesseling 1998; Acemoglu, De Feo, and De Luca 2020) and exclude cities further than 120km from the closest weather stations. Due to data availability, the interpolations for 1943 are based on 6-hourly weather reports, while for 1944, we use hourly reports; in both cases we first run the interpolations and then take an average for each day.³⁰

4. Results: Bombing

In our main analysis, we exploit variation in bombing intensity over time and space to explain resistance against the regime. Figure 5 gives a first impression: resistance in the top quintile of bombing volume was approximately 12 times higher than resistance in the bottom quintile, rising from 0.09 cases per month per million people to 1.14.

However, this correlational evidence should not be interpreted as causal: even though Allied bombing was highly inaccurate, it was not random. Omitted variables like military value,

²⁷ More precisely, we use the predicted signal strength and combine it with the information on actual listenership to infer acceptable levels of reception quality time. Other papers use similar functional forms (Olken 2009; Yanagizawa-Drott 2014; Adena et al. 2015).

²⁸ Note that signal strength on our scale is mostly negative. It means that the quality of reception was not as good as modern-day standards imply. At the same time, Figure 4 suggests that listeners were willing to accept this lower quality for listening to foreign radio during the war.

²⁹ Figure A.3 also reports the geographic distribution of our measure of BBC availability.

³⁰ Note that our panel regressions always include time fixed effects to deal with the concern of potentially different data quality over time.

population density and pre-existing skepticism vis-a-vis the Nazi regime could potentially explain this strong association. In order to eliminate those confounding factors, we use complementary sources of variation to deal with potential unobserved heterogeneity. We first report cross-sectional results from a spatial discontinuity-based exercise. Next, we exploit weather-induced variation in panel data. Finally, we analyze data from the victory records of German fighter pilots, analyzing how bombardment of their hometowns affected performance.

Basic Patterns: Bombers' Combat Range and the Geography of Resistance

We first exploit technical limitations of WWII aircraft for identification. Allied aircraft could not reach all German targets with equal ease. Aachen, on the Dutch border, is a mere 250 miles (405 km) from East Anglia, where most Allied bombers were stationed during 1939-1945. In contrast, Königsberg is 850 miles (1,368 km) away. The RAF's Lancaster bombers had a long range and could reach most German cities. In contrast, the American B-17—an older plane repeatedly upgraded with armor and numerous defensive weapons—had a more limited combat range. The official history of the US Army Air Force in World War II states:

“A typical mission by B-17s in the European theatre in 1944-45 would take them to Berlin, Munich, or Leipzig. From their airfields in East Anglia, the bombers would have a practical radius of 600 or 700 miles with a bomb load of 4,000 or 5,000 pounds... Longer missions were occasionally flown... with reduced bomb loads...” (Craven and Cate 1948).³¹

The value stated by the USAAF—600 miles—coincides with the maximum monthly range of attacks (with a full bomb load) flown by the US 8th Air Force (985 km). In Appendix H, we summarize how technical characteristics of B-17s, together with operational conditions, created this threshold. In our analysis, we consider all cities at a distance of less than 985 km to East Anglia to be within range of the 8th USAAF.

Figure 3 above shows a map of Europe with the maximum combat radius of B-17 bombers shown as a circle. As the map suggests, most of the bombing indeed occurred within B-17 range, with some occasional attacks outside the 985 km radius. Table 1 summarizes the extensive margin of bombing: Of the 149 cities in our sample outside the normal range of B-17s, only 14 were bombed at all—a rate of less than 10%. In contrast, out of the 875 cities in

³¹ The first operational model, the B-17B, had an effective combat range of 600 miles (Craven and Cate 1948). While later models had larger fuel tanks and better engines, the weight of armor and defensive armament also increased. Operating conditions in general made distances flown shorter than expected: “Prewar statistics on range of aircraft were generally found to be exaggerated when actual wartime experience brought home to the AAF the great host of factors affecting combat radius of action.” (Craven and Cate 1948)

the sample within range, 53% were bombed—an increase in relative risk by a factor of more than 5. The frequency of resistance per million inhabitants also jumped sharply in cities that were ever bombed: from a frequency of 0.08 in towns without bombing and outside the range of B-17s to 1.08 in those bombed and in range.³² Again, this raw comparison ignores potential differences between industrial cities in West versus East Germany. Because cities were deliberately targeted and not bombed at random, we next perform an RDD analysis.

To proceed, Figure 6 shows a heatmap of bombing and resistance within and outside of the B-17's range. Panel A demonstrates that most bombing occurred within 532 nautical miles (985 km) circle around the East Anglia airfields; it declines discontinuously when the maximum combat radius was reached. Similarly, panel B indicates that resistance was more likely to occur in places within the combat range of B-17 bombers, compared with places just outside the circle.³³

To go beyond the visual evidence, we denote resistance as R_i , distance to B-17 maximum range as D_i , and maximum bombing range as \bar{d} . We estimate

$$E[R_i(1) - R_i(0)|D_i = 0, \phi_m] = \lim_{d \downarrow 0} E[R_i|D_i = 0, \phi_m] - \lim_{d \uparrow 0} E[R_i|D_i = 0, \phi_m] \quad (1)$$

where ϕ_m are month fixed effects, capturing time-varying characteristics. The optimally chosen bandwidth (Imbens and Kalyanaraman 2012) is 201 km. Table 2 reports the results of this regression discontinuity analysis. Figure 7 shows the results graphically, zooming in for an even smaller bandwidth. The numerical analysis implies that with a simple RDD and a cut-off of 985 km, we observe a 3.0% higher number of monthly new cases of resistance in range of B-17 bombers (column 1), significant at the 5% level, and equivalent to 44% of a standard deviation. At the same time, average bombing was 0.156 log points higher within B-17 range, significant at 5% level, and equivalent to 24% of a standard deviation (column 2). Results from implementing a fuzzy RDD design, using bombing as the running variable imply that the elasticity of new resistance cases with respect to bombing is 0.191 (column 3, significant at 1% level). In other words, a doubling of bombing tonnage led to a 19.1% higher frequency of resistance, on average.

³² The rate of resistance is even a little higher in towns bombed but outside the range of B-17—but these were very rare. This suggests that bombing carried out by the RAF had similar effects to USAAF bombing.

³³ Two-dimensional versions of these graphs are also summarized in Figure A.4 in Appendix A. We also report the results of a McCrary test (McCrary 2008) in Figure A.5 in Appendix A. Even though the density of the population in general declines as the distance to East Anglia increases, there is no discontinuous jump in density at the threshold. Also, we should note that, as shown in the heatmap in Figure A.6, average city size does not seem to decline with distance, with perhaps exception of Berlin.

Some additional checks demonstrate the validity of our approach. For example, we also show the results for alternative cut-offs of 140km and 260km in Table A.2 of the Appendix A; the coefficient of interest for fuzzy RDD is broadly stable across specifications.³⁴ Table A.4 reports that the results are robust to donut specifications and excluding particular locations close to the maximum range, like Berlin or Munich.

Panel Results and Identification

The RDD estimates based on the B-17's combat radius suggest that bombing increased resistance. At the same time, unobserved characteristics of cities (like military importance) could be correlated with both a population's willingness to oppose the regime in power and geographical distance. This might create bias in our analysis. To deal with this possibility, we introduce a complementary identification strategy, which exploits the panel structure of the data and allows us to control for time invariant characteristics of cities. Note that even with fixed effects of cities taken into account, OLS estimates are still likely to be biased—strategically important cities were bombed earlier. At the same time, these cities might also be more likely foci for resistance. We therefore pursue an instrumental variable strategy.

We use the weather as a plausibly exogenous source of variation in bombing intensity. Specifically, we interact average daily wind across Germany with each city's distance to East Anglia. Wind has an effect on the speed and ultimately, on the range that aircraft could fly with a full load. The 8th USAAF (1945) summary of tactical conditions states (p. 90) that "...a strong wind at this altitude ... further reduced the effective radius of operations."³⁵ Therefore, on days with strong wind, planes were more likely to bomb targets closer to their bases.³⁶

The first stage results, reported in Table 3, confirm our logic: there is a negative relationship between wind and bombing for locations relatively far from East Anglia, while the

³⁴ Similarly, Table A.3 shows that for smaller bandwidths other potentially confounding variables do not jump for the lowest bandwidths considered.

³⁵ A tailwind increases outbound speed. On the return journey, the aircraft then faces a headwind. However, the effect is not symmetric. For example, a tailwind equal to planes' cruising speed would cut their time to target in half, but they would never return. Therefore, the stronger the wind is, the larger is the reduction in effective range.

³⁶ While clouds could be considered an alternative source of exogenous variation, they have opposing effects on bombing. On the one hand, they make it harder to find targets. On the other hand, they protect the bombers from being observed directly by anti-aircraft gun crew. There is no obvious relation to the flying range. The same holds for rain. Both perform poorly as an instrument in daily data. Therefore, we confine our attention to the interaction between wind and distance as an instrument.

relationship turns positive for closer targets.³⁷ We also find that it is wind conditions on the day of the bombing and the day before—but neither earlier nor later—that predict tonnage dropped on a target.³⁸ The effect of bombing on the day after can be explained by several factors: a direct effect on the bombing after midnight for planes that took off before midnight, and the indirect effect since the planning which targets to attack was often made on the day before and was influenced by weather conditions and wind speed on the early day being correlated with the wind speed on the evening before. Overall, the results in Table 3 demonstrate that bombing was influenced by day-to-day variation in wind speeds.

Next, to exploit variation over time in the intensity of bombing and the frequency of resistance, we estimate the following equation:

$$R_{im} = \beta_0 + \beta_1 Bombing_{im} + \phi_m + \mu_i + \epsilon_{im} \quad (2)$$

where R_{im} is a measure of new acts of resistance in city i in month m , $Bombing$ is measured in tons of bombs dropped, and we include month and city fixed effects. We take natural logs of bombing tonnage and resistance variables (plus one in both cases). Because $Bombing_{im}$ is a potentially endogenous variable, we instead report the results from the two-step procedure with bombing predicted from variation in the daily wind strength, as summarized in Table 3. Then, to be able to estimate equation (2) at the monthly level, we aggregate daily bombing, as predicted from the daily weather following specification in column 4 in Table 3, to the city-month level.³⁹ We cluster standard errors by city and month.⁴⁰

Table 4 presents the results of this estimation. Bombing led to a higher number of new resistance cases (column 1 of Table 4): a 100% increase in bombing tonnage predicts a 4.8% increase in the number of new resistance cases. Similarly, we find that bombing increased the probability of having at least one resistance case (column 3 of Table 4) by 3.8% following

³⁷ The opposite is true for locations that are closer to England. Specifically, we estimate the following non-linear equation $bombing_{it} = \alpha_0 + \alpha_1 wind_t distL_i + \alpha_2 wind_t distL_i^2 + \epsilon_{it}$ our daily data, which allows the effect of the wind to have a different sign depending on whether a target was relatively close or far from London. We find that for small distances, the effect of the wind on bombing was positive, while for large distances this effect turns negative (see the effects of wind for various percentiles of $distL$, computed in the last rows of Table 3).

³⁸ The coefficient for the day of bombing is significant at the 1% level (column 4 of Table 3). In contrast, the coefficients are one third in size and far from significant 1/2/3 days before or 2/3 days after the actual date of the attack.

³⁹ Numerically, we compute mean values of predicted bombing for each city and month, taking city and month fixed effects into account. We then take a natural log of this measure, to avoid uneven impact of outliers.

⁴⁰ We also report the results of estimation with Conley standard errors (Table A.5 in the Appendix).

100% increase in bombing tonnage induced by weather variation, with coefficients being significant at 5% level in all the columns of this table.⁴¹

Could the effect of bombing on resistance be explained by more Gestapo activity after a raid? We focus on new resistance cases (and not ongoing ones), mitigating this concern.⁴² Nevertheless, to rule out this possibility, we collected data on the number of arrests in each month and place, and control for the number of arrests in columns 2 and 4 of Table 4. The coefficients for arrests are numerically small and far from statistically significance. Furthermore, although arrests are included in the specification, they hardly change the coefficient for bombing (e.g. 0.48 without this control in column 1, 0.49 with a control for arrests in column 2). Thus, we conclude that contemporaneous Gestapo activity is unlikely to explain the estimated effect of bombing on resistance.⁴³

We also investigate pre- and post- trends in resistance in Table 5. Future bombing does not affect contemporaneous resistance activity, and, moreover, the effect seems to be concentrated precisely during the month of bombing, not later. The main takeaway message from this table is that there are no significant pre-trends in resistance before bombing actually took place.⁴⁴ Also, there is no significant heterogeneity in the effect of bombing with respect to pre-existing political preferences or racism (Table A.7).

Overall, the results in Tables 3–5 suggest that bombing created more resistance—in line with our findings from bombing range-based discontinuities (subsection 4.1). Note, however, that the panel IV identification strategy only allows us to estimate LATE, i.e. the effect of bombing driven by weather conditions on a given day. The true effect of bombing probably lies between 4.8% (panel IV estimates) and 19.1% (RDD estimate) for a 100% increase in bombing tonnage.

⁴¹ In Table A.6 in Appendix A we also report results from OLS regressions that are likely biased as explained above. The OLS coefficients are negative but not significant. That is consistent with the premise that more militarily important cities, which also tend to have higher growth in resistance, got bombed first (when total bombing volume was lower), thus masking the relationship between bombing and resistance.

⁴² Only in 12.5% of resistance cases in our sample did the arrest occur in the same month as the start of resistance.

⁴³ We also analyse the geography of bombing and resistance within Berlin. We estimate the effect of bombing on resistance using grid cell month variation, controlling for grid cell and time fixed effects. The assumption is that the Gestapo was equally active in all parts of Berlin, sidestepping the issue of the timing of persecution. This data and corresponding results are discussed in the Appendix B.

⁴⁴ We also investigated pre-trends for arrests in Appendix C, Table C.1.

Bombing and fighter pilots' performance

So far, we have examined the impact of bombing on domestic opposition; bombing arguably encouraged Germans already opposed to the regime to take action. In this section, we study the impact of bombing on the performance of leading German fighter pilots—i.e. in a population with, on average, positive attitudes towards the regime. Figure 8 shows that pilots hailed from all over Germany, while the airfields from which they flew covered all of occupied Europe and the European part of Soviet Union.

As the war wore on, an increasing number of fighter pilots' hometowns were hit by Allied bombing. We examine the performance of each fighter pilot as a function of his individual ability (a personal fixed effect C_i), experience (in months), front (East or West), as well as squadron (S_{it}), aircraft (A_{it}), and time fixed effects (K_t):

$$V_{it} = \alpha \text{Bombing}_{it} + \beta \text{Experience}_{it} + \gamma \text{Front}_{it} + C_i + \delta_{Kt} + \rho S_{it} + \theta A_{it} + \epsilon_{it} \quad (3)$$

where V is the number of 'victories' by pilot i in month t , $Front$ is a dummy that takes the value of unity if the pilot was posted to a squadron on the Eastern front, $Experience$ is measured in months since entry into our database, and $Bombing$ is a dummy that takes the value of unity after a pilot's home town has been bombed for the first time.⁴⁵ Standard errors are clustered by pilot.⁴⁶ Analogously, we estimate eq. (3) with the standard Cox model for exits (death, missing, POW, or wounded and not returning to combat).

Table 6, Panel A, shows the results. Pilots performed less well after their hometown was bombed for the first time. On average, the pilots in our data shot down 1.94 enemy planes per month. After the bombing of their hometown, their monthly tally declined by 0.42–0.57 aircraft when we estimate with pilot fixed effects. Even when controlling for pilot, time, and squadron fixed effects, we still find a decline in monthly victory rates of 0.42, or almost a quarter of the average success rate per month. In terms of the magnitudes, hometown bombing in 1942–1944 accounted for 1006 less enemy airplanes shot, or 22.5% decline (based on column 4, Table 6A specification).⁴⁷

Note that the distribution of standard errors for our explanatory variable 'home town bombed'

⁴⁵ Note that the time distribution of first bombing of pilots' hometowns was largely uniform over the period of our study (Figure A.7 in Appendix A).

⁴⁶ We also report the results of estimation with double clustering by pilot and month in Table A.8 in the Appendix.

⁴⁷ The counterfactual applies to the 352 aces in our data. If the effect applied similarly to all German fighter pilots, the overall decline would be even larger (German pilots with at least one victory claim shot down 54,829 Allied aircraft. A 25% reduction for 22.5% of the sample of pilot-months would translate into the 2,775 planes 'saved'.

may be non-standard, since it reflects an absorbing state. To deal with this issue, we employ randomization inference: we create randomly-assigned bombings of home towns, generate placebo treatments, and run this against actual monthly victory rates of pilots 1,000 times. The results are displayed in Figure 9. Our OLS coefficient lies at the extreme lower end of the distribution of simulated coefficients. This underlines the statistical significance of our results.

In our difference-in-difference estimation, all untreated pilots effectively act as the comparison group for the ‘treated’ pilot whose hometown was bombed. In a setting with substantial heterogeneity in performance across pilots (and over time), this is not ideal. To demonstrate the robustness and size of the treatment effect, we also use synthetic control group analysis. Here, for each treated pilot i , we form a comparison group of pilots that (with appropriate weights) performed similarly to i in the period leading up to the treatment (Abadie, Diamond, and Hainmueller 2010). In our particular case, with different treatments at different points in time, we use the modified synthetic control approach of Xu (2017), based on interacted fixed effect models.⁴⁸

Figure 10 reports the result of this estimation. In panel A, we plot the month-by-month deviation in victory rates between pilots whose home town is bombed at $t=0$, and those pilots whose pre-bombing performance is similar. Panel B displays the cumulative effect. The effect of bombing is immediately visible at $t=0$, and then grows in magnitude. The maximum deviation is almost 2 aircraft per month, suggesting a 100% decline of performance at its lowest point. The change remains significant even 30 months after a pilot’s first home-town bombing. At a horizon of 20 months, the total cumulative effect amounts to 20 fewer enemy aircraft shot down (Figure A.9). Overall, both the evidence from standard diff-in-diff analysis and synthetic control methods suggests a major reduction in the motivation of high-flying German soldiers in response to (home town) bombing.

After a pilot’s hometown was bombed, pilots’ exit rates also declined (Table 6, panel B). The vast majority of exits in our data are caused by death – but the variable can also reflect pilots being shot down and taken POW, wounded and not returning to combat, or MIAs. We find a marked reduction in the risk of exit, by between a quarter and over 40%.⁴⁹ The combination

⁴⁸ Note that our data is heavily imbalanced because of pilot entry and deaths (cf. Figure A.8).

⁴⁹ Since death is an absorbing state, we cannot estimate with pilot FE; Cox regressions with time FE do not converge.

of lower ‘victory’ rates and fewer exits implies that bombing reduced motivation and effort, reflected in less risk-taking and ‘success’.

One obvious concern is that pilots may have been stationed near their hometowns, and that their own operations were accordingly interrupted by bombing raids. Figure 8 shows the location of Luftwaffe airfields used by pilots in our data as well as their hometowns. The vast majority of pilots operated from airfields far away. Also, the analysis in Table 6 uses a simple indicator of bombing in a pilot’s hometown, coding the month of the *first* attack and all subsequent months as unity. Could the effect instead be cumulative, rising in magnitude; or conversely, were there diminishing returns from ever more attacks? Figure A.10 plots the coefficient on home town bombing when we split the order of attacks into 1st-5th, 6th-15th, and >15th, controlling for pilot and time fixed effects.⁵⁰ We also augment our estimation from Table 6, restricting the sample to pilots whose current airfield (at the time of the bombing attack) was at least 250, 500, or 750 km away from their home town. The coefficient rises in size with distance, suggesting that operational disruptions after bombing raids are not responsible for declining performance. Coefficients are significant at the 90% level throughout. If anything, the magnitude of the effect increases as ever more attacks hit a pilot’s hometown.

According to narrative reports, when air attack destroyed the hometowns of servicemen, their morale often suffered (Hastings 1981).⁵¹ The quantitative evidence on German fighter pilots demonstrates the size of this effect – the more the cities of the *Reich* turned into heaps of rubble, the fewer victories even *Luftwaffe* aces scored, and the smaller the risks they took.

5. Radio and Resistance

So far, we have analyzed the impact of bombing on resistance as well as the motivation of German soldiers. This section studies the effect of the BBC German service on opinions using the USSBS survey. We also test whether radio availability led to more resistance and examine the interaction of propaganda and bombing. First, we investigate how radio reception was related to self-reported BBC listening as stated in the USSBS survey.

⁵⁰ The results of this analysis are also summarized in Table A.9 in the Appendix.

Listenership to BBC and Perceived Bias of German propaganda

In this section, we analyze the impact of BBC signal strength on both self-reported listenership to foreign radio and Germans' perception of bias in information provided by the German government, as derived from the USSBS.⁵¹ We estimate the following equation:

$$y_{ic} = \alpha_0 + \alpha_1 BBC_c + \alpha_2 X_{ic} + \epsilon_{ic} \quad (4)$$

where y_{ic} is a self-reported opinions of respondent i in city c , BBC_c is a measure of BBC availability, as described above, and X_{ic} is a vector of individual level controls. The identifying assumption is that BBC availability only affects individual's opinion through listening to BBC.⁵² Standard errors are clustered at city level.

Table 7 summarizes these results. Odd columns report the results without additional controls, while even columns also add individual controls. Higher BBC availability based on signal strength translated into higher listenership of Radio London (columns 1–2) as well as of any Allied radio station (columns 3–4).⁵³ A one standard deviation increase in BBC availability led to 10.1% increase in the probability of (reported) listening to Radio London, and a 7.9% increase for any Allied radio station.

Furthermore, BBC listening decreased people's confidence in German government propaganda. Columns 5–6 report this relationship either without or with demographic controls. Column 6 suggests that a one standard deviation increase in BBC predicted availability predicts a 21.8% increase in people reporting self-perceived bias in German information. This result is consistent with radio changing people's evaluation of information from various sources.⁵⁴

Radio Reception and Resistance

Did better radio reception of Radio London lead to more resistance? We first examine the effect of signal strength, and then analyze interaction effects with Allied bombing.

⁵¹ As discussed above, the USSBS survey may suffer from social desirability bias. At the same time, we do not expect this bias to vary systematically for cities in our analysis.

⁵² In Table A.10 in the Appendix, we report how survey demographics were related to BBC availability. Consistent with our identifying assumption, we did not find a significant relationship.

⁵³ Respondents sometimes could confuse foreign radio stations. We therefore show the results for listening to Radio London and to any Allied radio station separately.

⁵⁴ We present further results based on USSBS data in Appendix D. In particular, we find that the earlier people self-report starting to listen to the BBC, the earlier they held the belief that the war was lost or wish to end the war, in a panel framework controlling for individual fixed effects (Table D.1). We also find that both exposure to BBC and its interaction with bombing were associated with markedly different opinions about the war, the Nazis, and occupation (Table D.2).

We start by looking at the direct effect of predicted BBC radio availability on resistance. The results indicate that it had a positive effect on resistance, significant at 10% level (Table 8, columns 1–3) once pre-existing political preferences are controlled for. The effect is relatively small, with a one standard deviation increase in BBC signal availability leading to a 0.32% increase in resistance.⁵⁵

Next, we study complementarities between BBC availability and bombing intensity. Column 4 of Table 8 summarizes the results of the corresponding panel estimates. We use a 2SLS specification, predicting bombing volume from wind speed, as discussed earlier. This suggests a positive interaction between bombing and BBC radio reception: radio and bombing reinforced each other. The magnitude implies that for the highest level of BBC availability, a doubling of bombing led to an 8.3% increase in resistance. For the lowest value of BBC availability, the effect of bombing is close to zero; it is not significant at conventional levels. Put differently, a one standard deviation increase in BBC availability across Germany would have generated the same level of domestic opposition, even if bombing had declined by 25%.

6. Conclusions

Can air power and propaganda contribute to victory? Or are drone strikes on suspected terrorist camps, for example, counterproductive, resulting in the recruitment of yet more terrorists (Shah 2018; Kattelman 2020; Piazza and Choi 2018)? We examine the effect of Allied bombing and propaganda on domestic resistance against the Nazi regime in WWII Germany. US and British bombing increased internal resistance against the Nazi regime. Despite the Gestapo's effectiveness and the Nazi regime's propaganda prowess (Evans 2008), we find that a combination of Allied radio propaganda and military force fanned the flames of resistance in Germany's ruined cities; it also sapped morale at the front. The more German cities burned and turned into rubble, and the more Germans could listen to the BBC, the clearer it became that the war was lost – and the more likely active acts of domestic resistance became (USSBS 1945).

We exploit spatial variation in bombing and radio coverage to support this argument. In addition, we use variation in the intensity of bombing over time. Exogenous variation in bombing driven by weather conditions demonstrates that the effect is arguably causal. In

⁵⁵ Given that we can only estimate functional form of S-curve using USSBS survey, and jamming being used to depress the quality of the signal, this measure is likely to be noisy, thus our coefficient here is likely to be underestimated.

addition to instigating resistance against the Nazi regime, bombing decreased the combat motivation of German fighter pilots, undermining the performance of Germany's military machine. Effects were large: The magnitudes imply that a 100% increase bombing led to 19.1% higher resistance in the RDD specification, and to 4.8% higher resistance in the panel specification. When a pilot's hometown was bombed, his monthly rate of destroying Allied aircraft fell by 20-30%.

Bombing became more effective when combined with BBC propaganda. Using terrain characteristics to identify exogenous variation in radio listenership, we demonstrate that German government strictures against listening to foreign stations were issued with good reason: foreign radio created more resistance, especially in those towns and cities where bombing was heavy. The message that Germany was losing the war became more convincing under a hail of bombs (Brader, Valentino, and Suhay 2008)(Marcus et al. 2005). In the USBSS survey, Germans exposed to BBC radio held markedly more pessimistic views about the course of the war. Our results imply that a one standard deviation increase in BBC listening had the same effect on domestic resistance as a 25% increase in bombing tonnage. Since the bombing of Germany claimed the lives of an estimated 360,000 civilians in German, and of 76,000 Allied airmen, this implies a potential 'saving' of 112,000 lives.

The effectiveness of history's second-greatest bombing campaign, and of allied radio propaganda, has largely been dismissed in the historical literature: no mass uprising took place in Germany during World War II, and no attempt to overthrow the regime was successful. Nonetheless, we argue that city attacks worked as intended, crushing the morale of the German people. While the overall course of the war was not altered by domestic German opposition, we can gain insight into the general effects of bombing from the German experience. The ultimate failure of air attack to instigate major unrest largely reflects the Nazi government's capacity to suppress opposition. In other words, the Gestapo's ruthlessness and efficiency ensured that bombing and propaganda did not map into an effective domestic resistance movement. Bombing also had important military knock-on effects – it undermined the fighting spirit of the German army, as evidenced by the declining motivation of fighter pilots; and it caused the Nazi regime to divert artillery and fighter aircraft to protect the Reich on a major scale. As in the case of Vietnam (Dell and Querubin 2018), the government's failure to protect its citizens from bombing undermined its legitimacy. Foreign air attack, especially when combined with the effective use of mass media, can bring people to resist their own government – even against heavy odds, and at the potential price of their lives.

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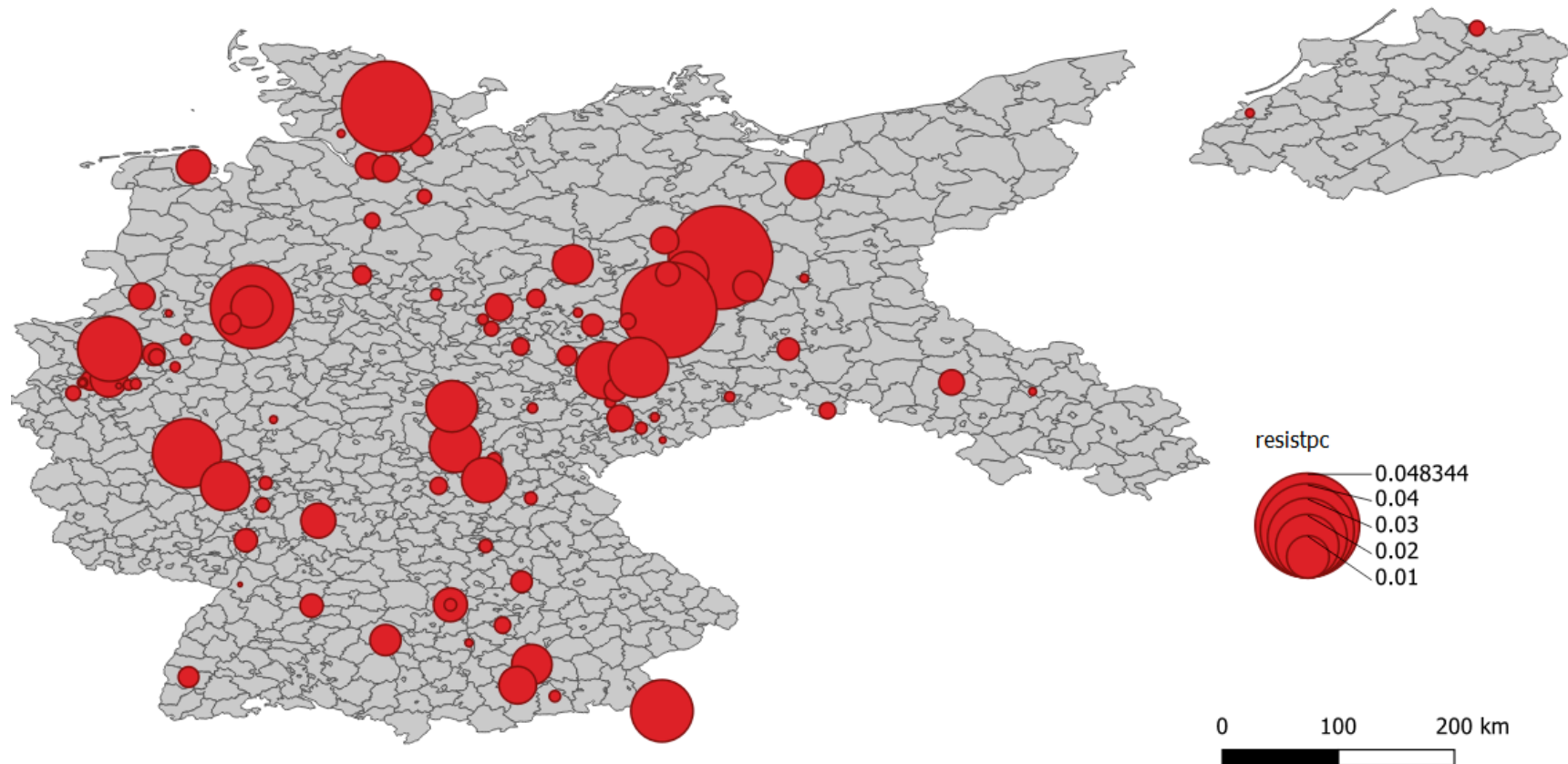
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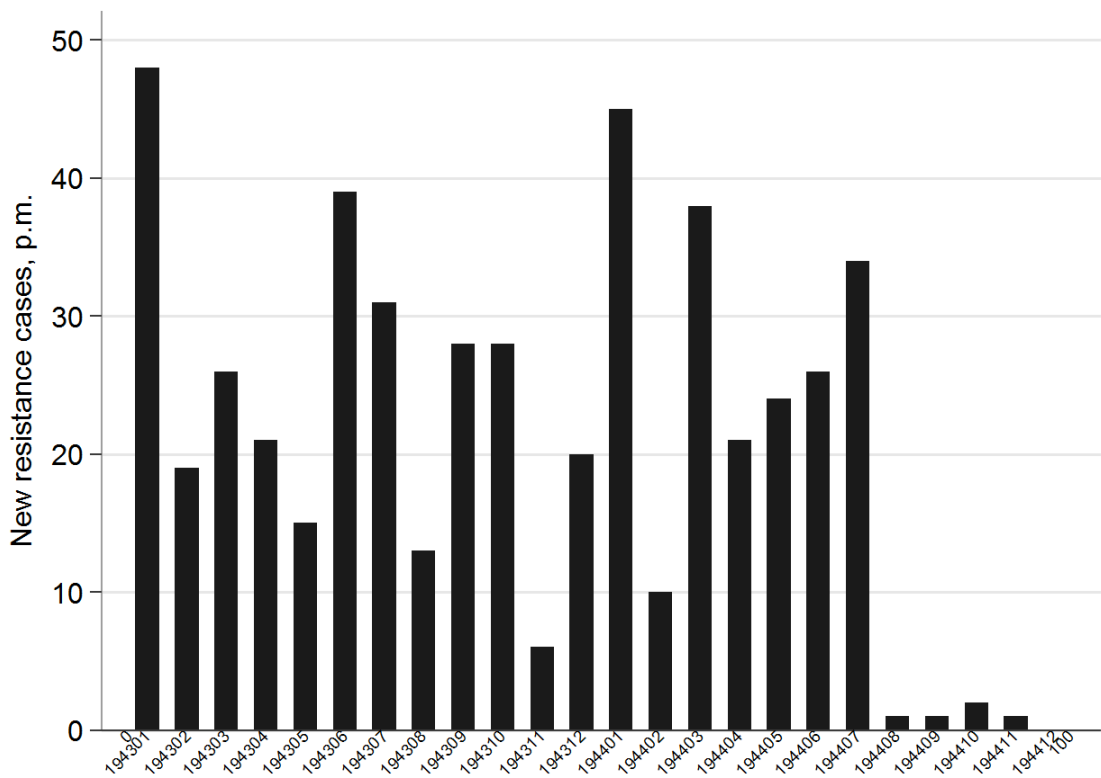
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Figure 1: Geography of Resistance, 1943-1944.

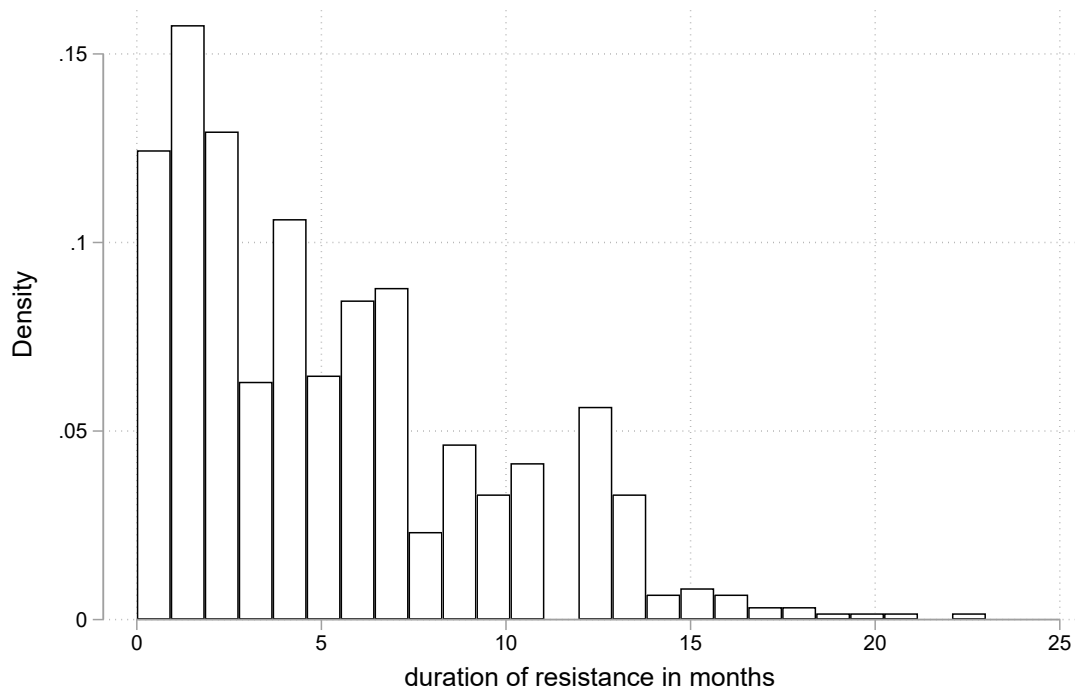


Note: The map shows the place of residence, for subjects charged with high treason, before the People's Court (Volksgerichtshof).

Figure 2. Start of new resistance by month and duration of resistance activity, in months.

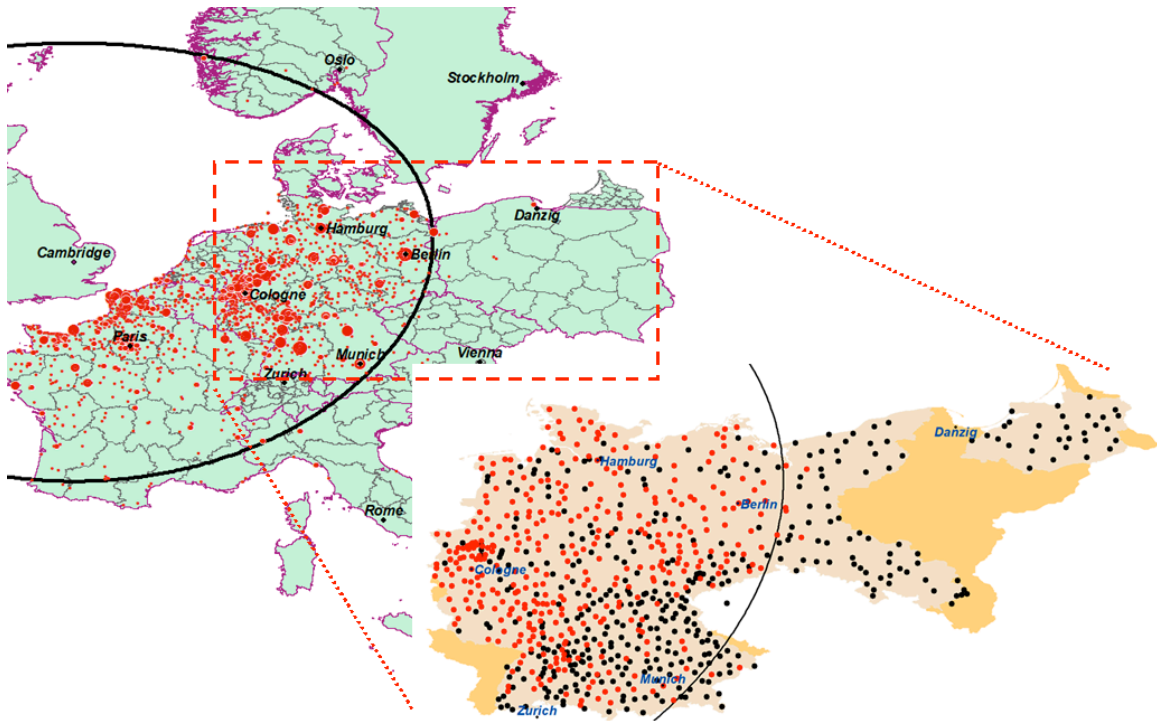


Panel A. Timing of New Resistance Cases (People involved, p.m.)



Panel B. Time between Initiation of Resistance Activity and Arrest (in months)

Figure 3. Map of Allied Total Bombing across Germany and Maximum Bombing Range.



Note: In the upper map, the size of dots corresponds to the overall volume of bombs (tonnage dropped). In the lower map, black dots indicate un bombed towns and cities (by 12/1944). The black line indicates the effective combat range of B-17 bombers by 1943 (985 km).

Figure 4. BBC Signal Strength and (USSBS Self-Reported) Listenership to BBC.

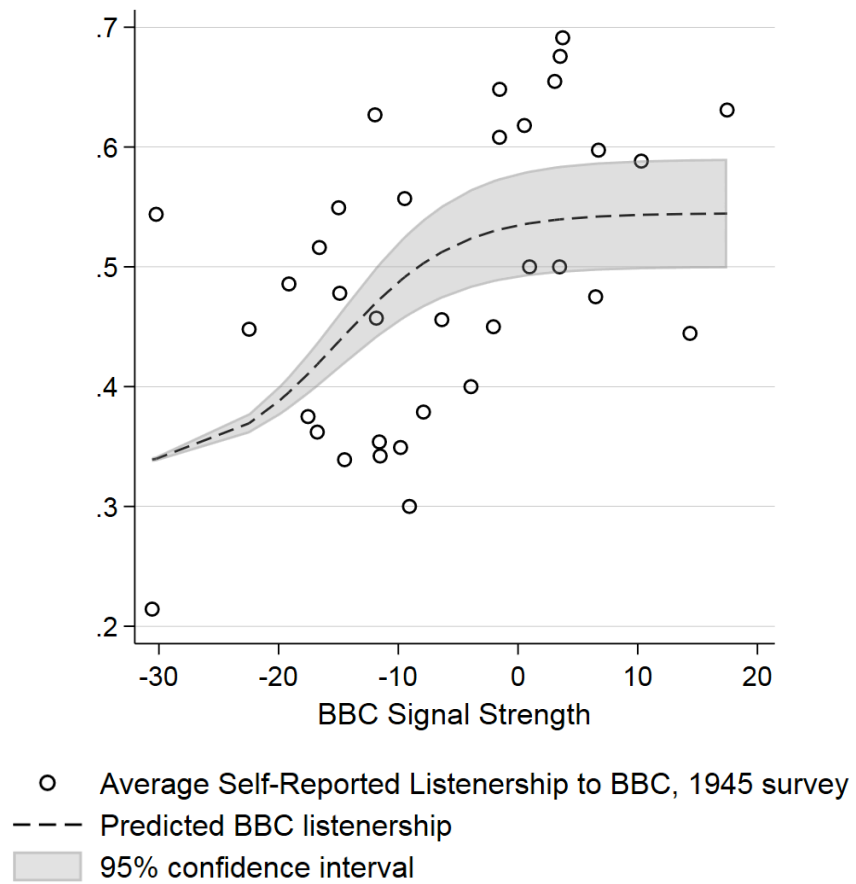


Figure 5. Binscatter plot for bombing and resistance.

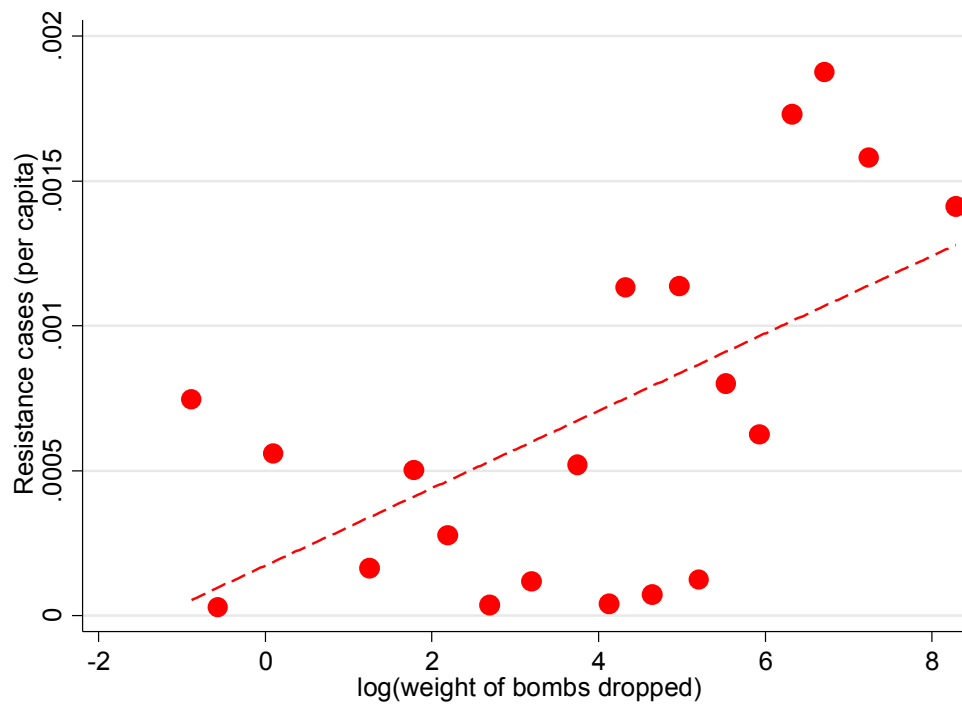
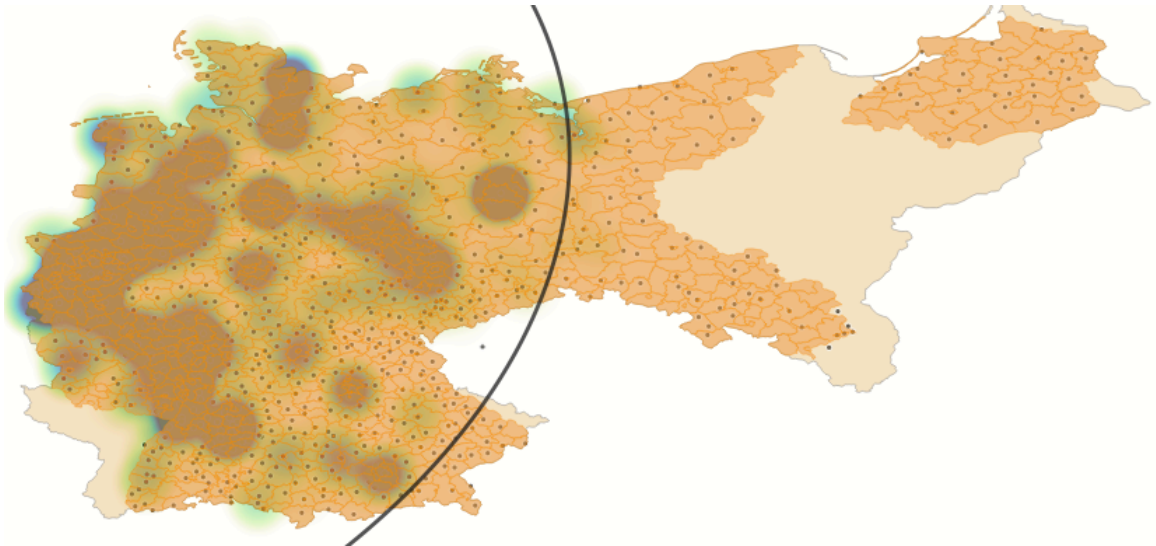
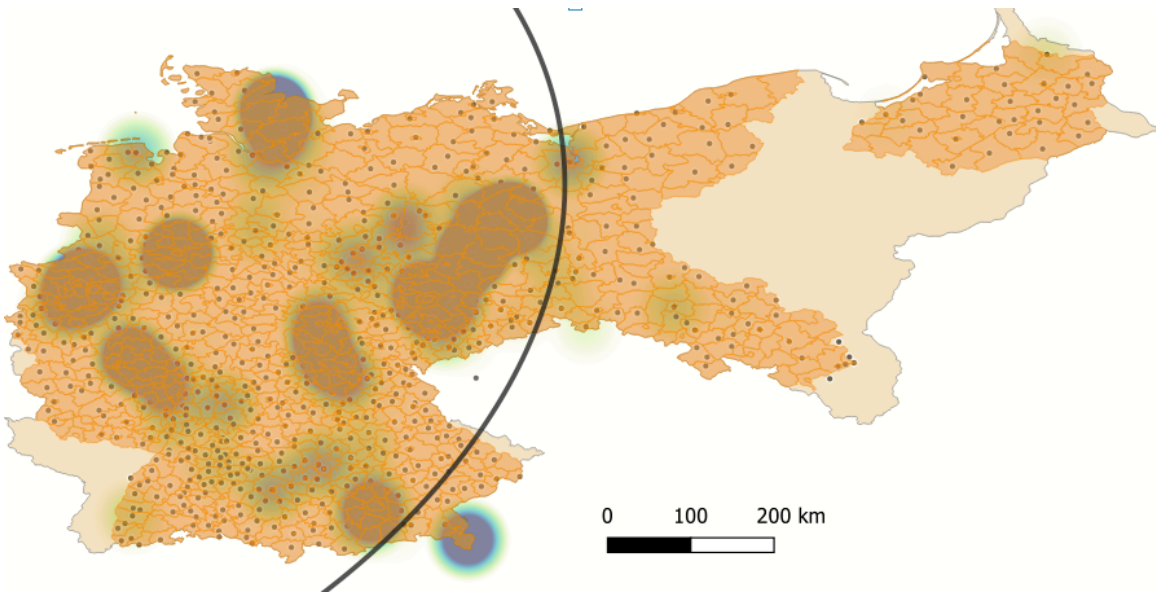


Figure 6: Bombing, Resistance, and Distance to Chelmsford, East Anglia.



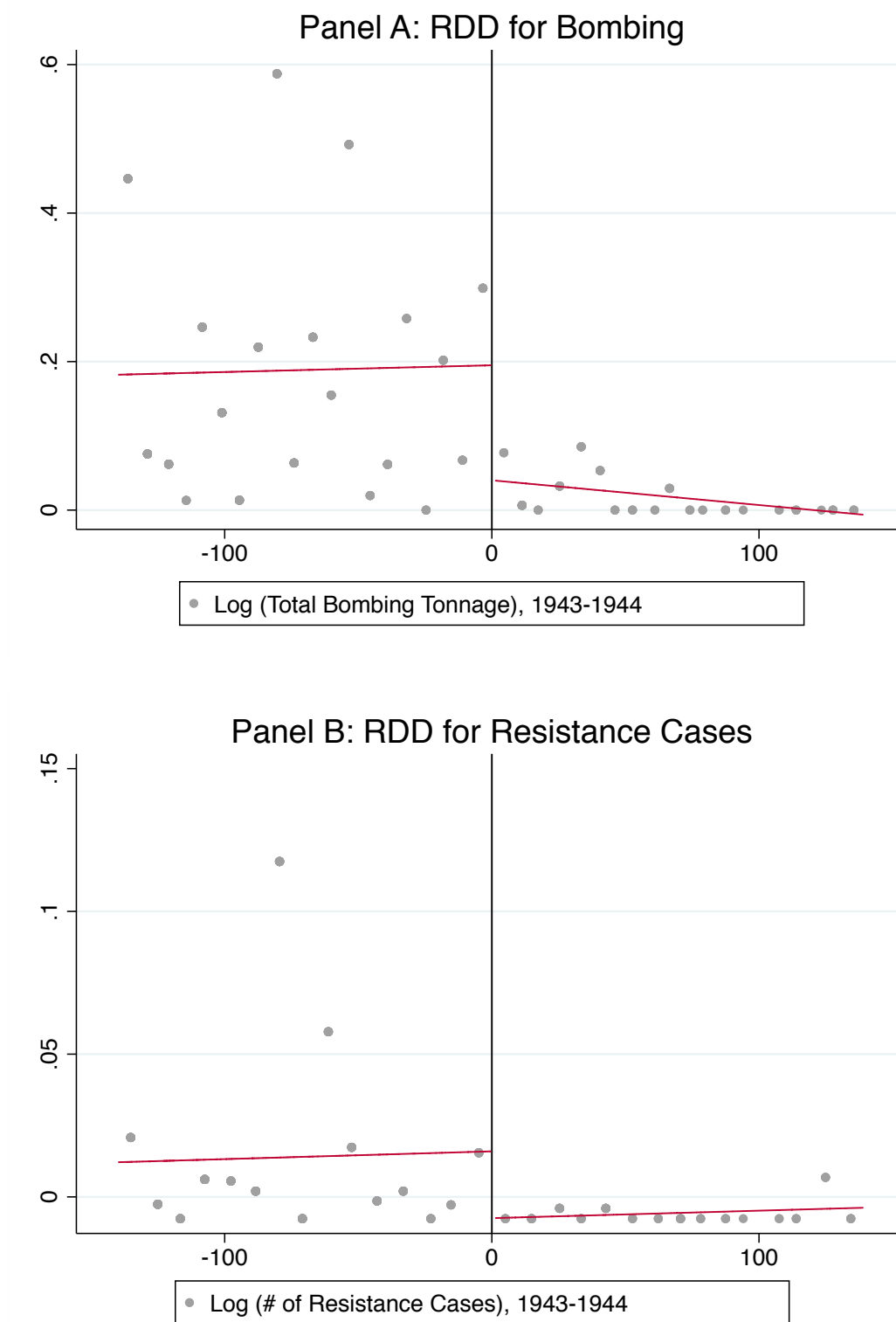
Panel A: Heatmap of (log) Bombing in Germany



Panel B: Heatmap of Resistance p.c. in Germany

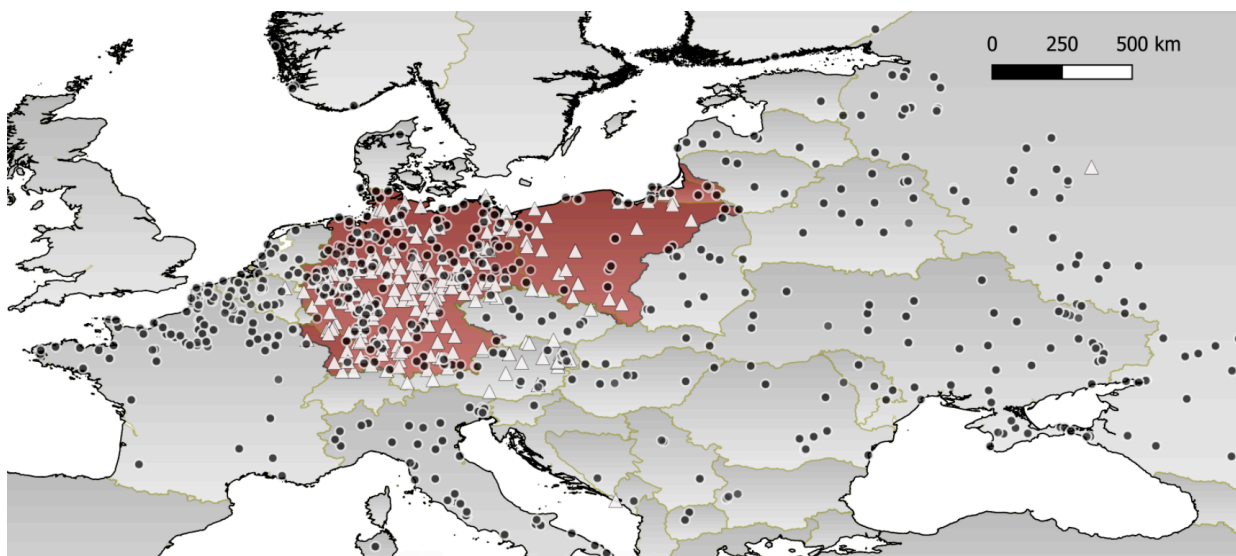
Note: The two maps show bombing volume (in logs) for 1943-44 (Panel A) and the incidence of resistance (p.c.) using 1938 population as a scaling variable. Darker areas were bombed more heavily and showed more resistance. Areas of Germany in 1938 in darker color. Dots indicate towns and cities in our dataset. We exclude annexed Austria as we do not include it in our study.

Figure 7. Regression Discontinuity Graphs.



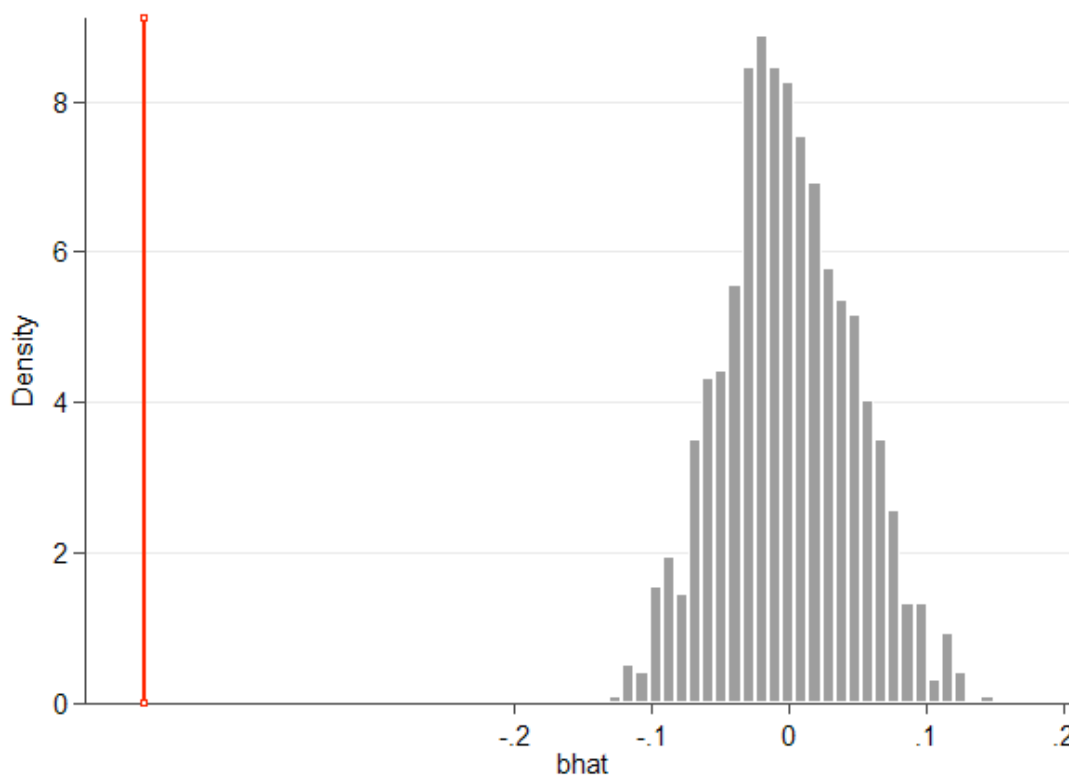
Note: Regression discontinuity plots are constructed following Calonico et al. (2014a, 2014b) robust RDD procedures. Figure A. 5 in the Appendix reports similar results for bombing and resistance per capita.

Figure 8: Location of Fighter Pilot Home Towns and Airfields



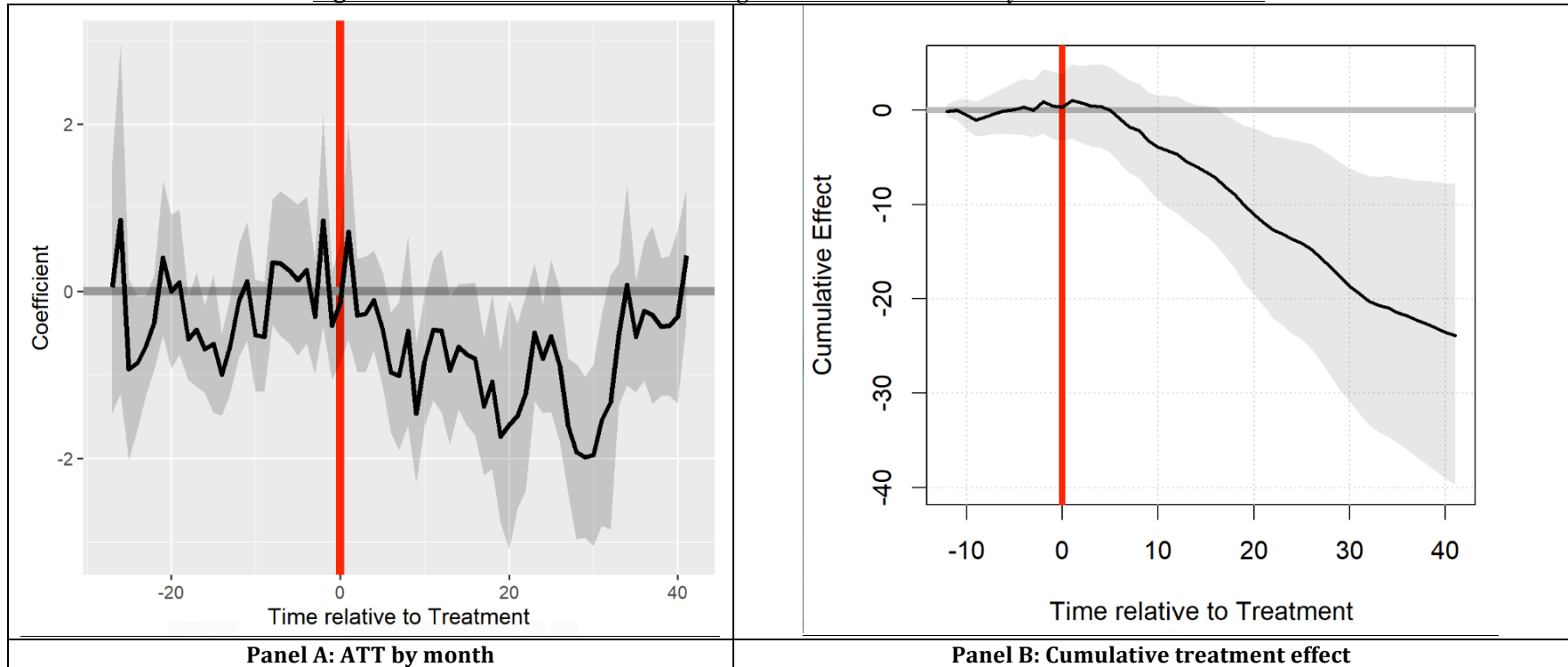
Note: The map shows the location of airfields used by pilots in our dataset (black dots) and their birthplaces (white triangles).

Figure 9: Distribution of randomly generated “bombing at home” coefficients vs estimated coefficient for fighter pilots’ performance.



Note: The histogram reports regression coefficients from a randomization exercise. We randomly assign home bombing to pilots’ hometowns 1,000 times, and run this variable against actual victories. Coefficients reported are from the specification with pilot fixed effects, squadron fixed effects, and time fixed effects (column 4 of Table 6A).

Figure 10. Effect of Home Town Bombing on Pilot Performance – Synthetic Control Method.



Note: The figure shows the effect of bombing a pilot's home town on monthly victories. The left panel (A) shows the effect month-by-month; the right (B) shows the cumulative impact. Time of home-town bombing is normalized to zero and indicated by a red line. The coefficient is derived from 1,000 bootstrap iterations of the synthetic control procedure described in Xu (2017). The coefficient is equivalent to the change in the number/cumulative number of Allied aircraft shot down per month.

Table 1: Bombing, B-17 Maximum Range, and Resistance

		No	Yes	sum/average
		Any bombing		
		Count		
In B-17 range	No	135	14	149
	Yes	412	463	875
		Any resistance		
		Count		
In B-17 range	No	142	7	149
	Yes	761	114	875
		per million inhabitants		
In B-17 range	No	0.08	1.4	0.2
	Yes	0.28	1.08	0.7

Table 2: RDD results – Resistance and Bombing.

	Log (New Resistance Cases)	Log (Total Bomb Tonnage)	Log (New Resistance Cases)
	Sharp RDD		Fuzzy RDD
	(1)	(2)	(3)
In range	0.030** [0.015]	0.156** [0.070]	
Log (Bombing), average			0.191*** [0.070]
Observations	429	429	429

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Fuzzy RDD is estimated as an IV with distance to the max operational range (985 km) as the running variable. Optimal bandwidth (201 km) is chosen following Imbens and Kalyanamaraman (2012). Linear distance terms on both sides of discontinuity are included, but not reported. Resistance is the average residual of the log of monthly beginning resistance activity (+1) on month dummies. The results look very similar in the panel version of this estimation. Table A2 shows how these results look like for alternative bandwidths.

Table 3: Predicting daily bombing from wind and distance to London

	Bombing, 3 days before (1)	Bombing, 2 days before (2)	Bombing, 1 day before (3)	Bombing, same day (4)	Bombing, 1 day later (5)	Bombing, 2 days later (6)	Bombing, 3 days later (7)
Average wind x Distance to London	0.227 [0.194]	0.181 [0.194]	0.081 [0.193]	0.583*** [0.193]	0.598*** [0.194]	0.279 [0.194]	-0.069 [0.194]
Average wind x (Distance to London)^2	-0.275 [0.236]	-0.267 [0.236]	-0.226 [0.235]	-0.718*** [0.235]	-0.642*** [0.235]	-0.266 [0.236]	0.066 [0.236]
City Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Full effect of wind at minimum of distance	0.047	0.028	-0.008	0.118	0.138	0.071	-0.017
p-value of full effect of wind at minimum	0.265	0.498	0.855	0.005	0.001	0.091	0.680
Full effect of wind at 25th percentile of distance	0.038	0.014	-0.031	0.095	0.129	0.072	-0.018
p-value of full effect of wind at 25th percentile	0.318	0.711	0.425	0.014	0.001	0.063	0.652
Full effect of wind at 50th percentile of distance	0.021	-0.008	-0.059	0.048	0.098	0.064	-0.015
p-value of full effect of wind at 50th percentile	0.521	0.813	0.074	0.144	0.003	0.057	0.648
Full effect of wind at 75th percentile of distance	-0.005	-0.039	-0.094	-0.022	0.045	0.046	-0.011
p-value of full effect of wind at 75th percentile	0.880	0.283	0.009	0.541	0.218	0.211	0.770
Full effect of wind at maximum of distance	-0.109	-0.152	-0.213	-0.297	-0.177	-0.036	0.010
p-value of full effect of wind at maximum	0.325	0.169	0.053	0.007	0.110	0.747	0.928
Observations	684,216	684,216	684,216	684,216	683,280	682,344	681,408
R-squared	0.015	0.015	0.015	0.015	0.015	0.015	0.015

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Distance to London is measured in 1000s of kilometers.

Table 4: Bombing (Predicted by Weather) and Resistance

	Log(New Resistance Cases)		At least 1 new resistance case (dummy)	
	(1)	(2)	(3)	(4)
Predicted Bombing	0.048** [0.021]	0.049** [0.022]	0.038** [0.017]	0.038** [0.017]
Log (Arrests)		-0.032 [0.033]		-0.000 [0.025]
City Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Observations	22,464	22,464	22,464	22,464
R-squared	0.393	0.394	0.186	0.186

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1. Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

Table 5: Bombing (Predicted from Weather), and Resistance – Post- and Pre-Trends

	Log(New Resistance Cases)				
	(1)	(2)	(3)	(4)	(5)
Log (Bombing), 2 months later	0.020 [0.022]				
Log (Bombing), 1 month later		0.035 [0.023]			
Log (Bombing), same month			0.048** [0.021]		
Log (Bombing), 1 month earlier				0.016 [0.035]	
Log (Bombing), 2 months earlier					-0.021 [0.044]
City Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	22,464	22,464	22,464	21,528	19,656

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1. Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

Table 6: Fighter Pilot Motivation and Bombing of Home Towns

Panel A:					
	Number of enemy planes shot down				
	(1)	(2)	(3)	(4)	(5)
Hometown Bombed	-0.175*	-0.572***	-0.472**	-0.437*	-0.422*
	[0.094]	[0.212]	[0.204]	[0.25]	[0.251]
Experience	-0.009***	0.0117***			
	[0.002]	[0.0040]			
Eastern Front dummy	1.690***	1.841***	1.425***	1.250***	1.258***
	[0.070]	[0.137]	[0.162]	[0.175]	[0.178]
Pilot Fixed Effects		Yes	Yes	Yes	Yes
Time Fixed Effects			Yes	Yes	Yes
Squadron Fixed Effects				Yes	Yes
Aircraft Fixed Effects					Yes
Mean of Dependent Variable	1.94	1.94	1.94	1.94	1.94
Observations	13983	13983	13983	13957	13957
R-squared	0.041	0.137	0.205	0.233	0.235
Panel B:					
		Exit			
	(1)	(2)	(3)	(4)	
homebombed_ever	0.753*	0.775	0.763*	0.569***	
	-0.117	-0.121	-0.119	-0.115	
exp		0.977***	0.976***	0.984*	
		-0.00443	-0.00453	-0.00801	
front			0.797	0.931	
			-0.115	-0.272	
Mean of Dependent Variable	0.0154	0.0154	0.0154	0.0154	
Observations	13983	13983	13983	13983	

Robust standard errors, clustered by pilot id, in brackets. *** p<0.01, ** p<0.05, * p<0.1. Unit of observation is pilot-month. Exponentiated coefficients from Cox regressions in Panel B. Exit is defined as KIA or severely wounded.

Table 7: Radio Availability, Self-reported Listening, and Perception of Bias in German Sources

	Listened to Radio London		Listened to Allied Radio Broadcasts		Perceived bias in German sources of information	
	(1)	(2)	(3)	(4)	(5)	(6)
BBC Radio Availability	0.650*	0.500*	0.631*	0.533*	0.451***	0.462***
	[0.350]	[0.275]	[0.321]	[0.290]	[0.135]	[0.128]
Demographic controls		Yes		Yes		Yes
Observations	2,282	2,272	2,282	2,272	1291	1277
Number of Cities	34	34	34	34	34	34
R-squared	0.008	0.066	0.009	0.058	0.007	0.021

Robust standard errors in brackets, clustered by city. *** p<0.01, ** p<0.05, * p<0.1. Demographic controls include gender, age, age squared, high school education dummy, and being married. Radio availability is predicted from the signal strength in each city.

Table 8: Resistance, BBC Radio, and Bombing 1943-44

	Log (# of Resistance Cases), 1943-1944			Log(New Resistance Cases)
	OLS	OLS	OLS	2SLS
	(1)	(2)	(3)	(4)
BBC Radio Availability	0.019	0.028*	0.031*	
	[0.012]	[0.017]	[0.017]	
BBC Radio Availability * Predicted Bombing				0.144*
				[0.087]
Predicted Bombing				0.094**
				[0.041]
Socioeconomic + geographic controls	Yes	Yes	Yes	
Elections controls		Yes	Yes	
German radio availability			Yes	
City Fixed Effects				Yes
Month Fixed Effects				Yes
Observations	865	865	865	22,296
R-squared	0.137	0.141	0.146	0.394

Robust standard errors in brackets, clustered by district. *** p<0.01, ** p<0.05, * p<0.1. The unit of observation is a city (columns 1-3) and city-month (columns 4-5). Geographic controls include distance to London and altitude. Socioeconomic controls include district population in 1938, share of welfare recipients in 1932, share of social renters in 1932, property tax in 1930. Election controls are from 1933 and include votes shares of NSDAP, KPD, SPD, and turnout. German radio availability is computed for 1940.

APPENDIX A: ADDITIONAL TABLES AND FIGURES

Figure A. 1: Map of USAAF 8th AF airfields.

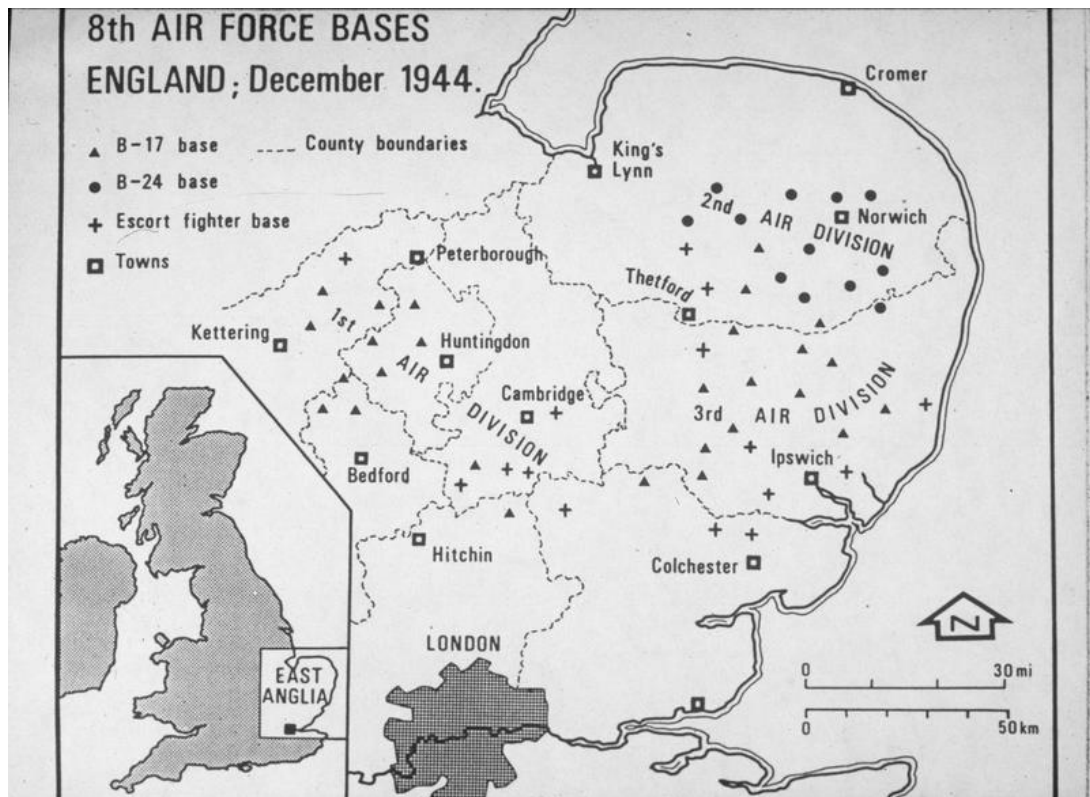


Figure A. 2: BBC Radio Predicted Availability over German territory.

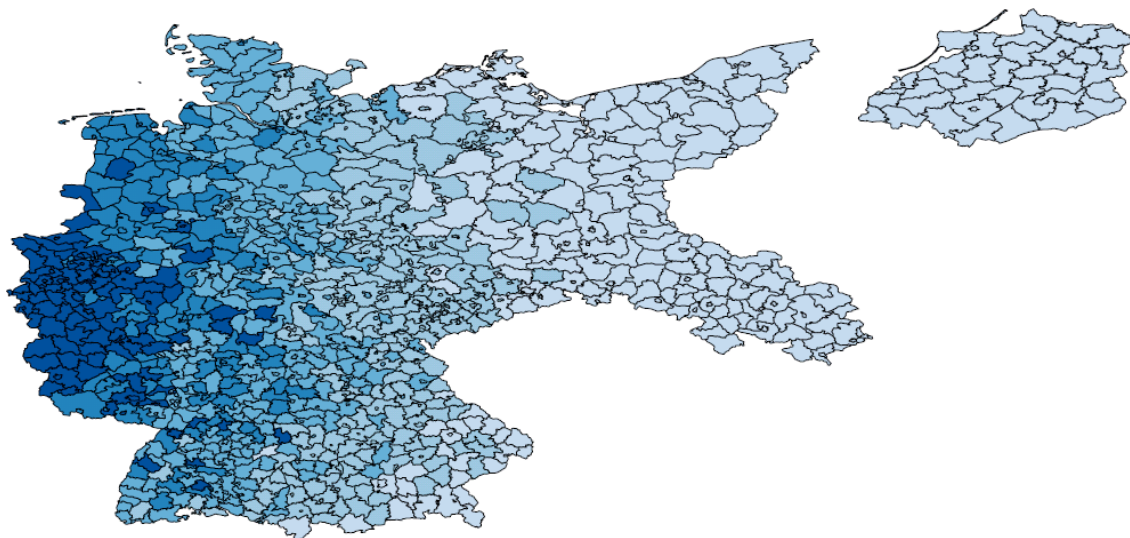


Figure A.3: Bombing, Resistance, and Distance to Chelmsford, East Anglia.

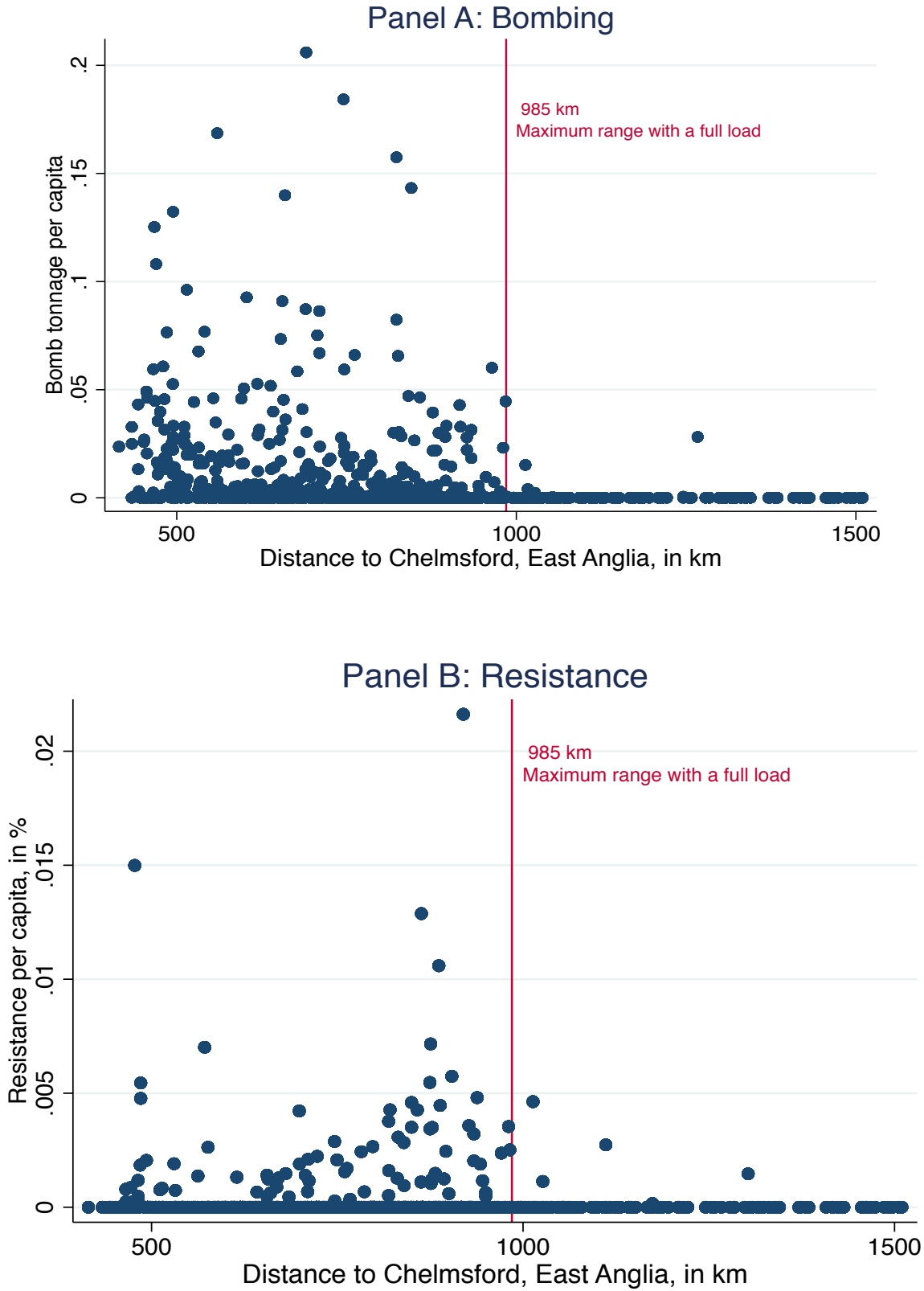


Figure A. 4: McCrary Density Plot.

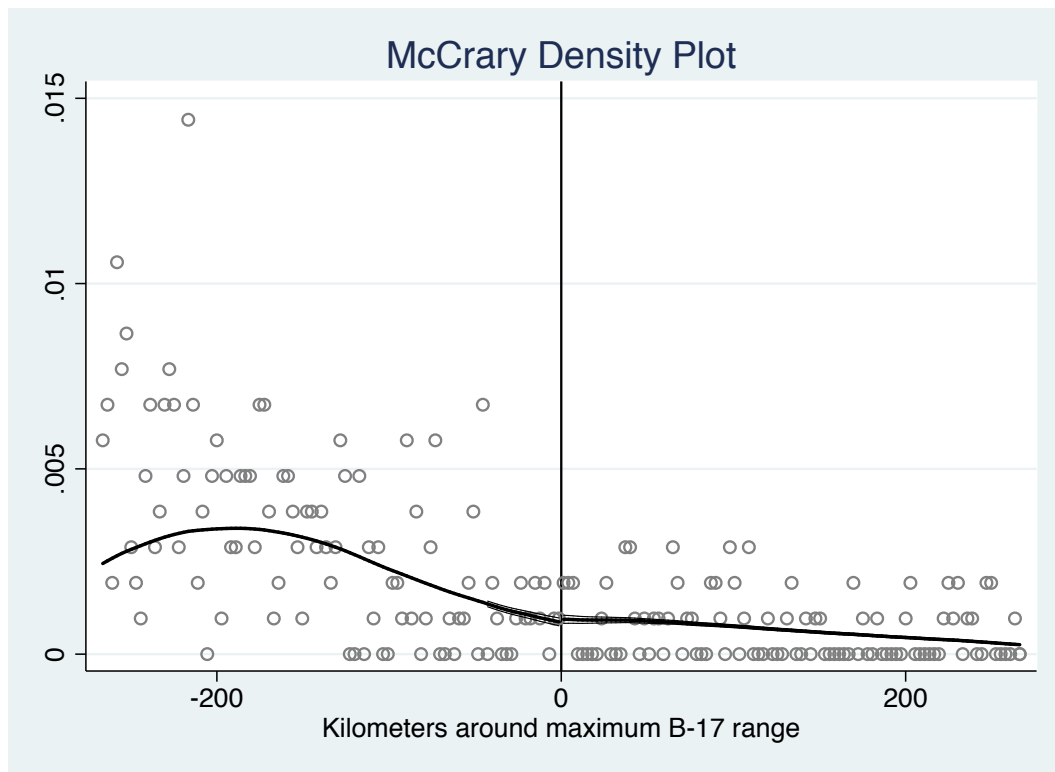


Figure A. 5: Population distribution in Germany.



Note: The area of each dot is proportional to the size of a city. The black line indicates the maximum operational range of B-17 bombers operating from East Anglia, as described in the text.

Figure A. 6: RDD for per capita bombing and resistance

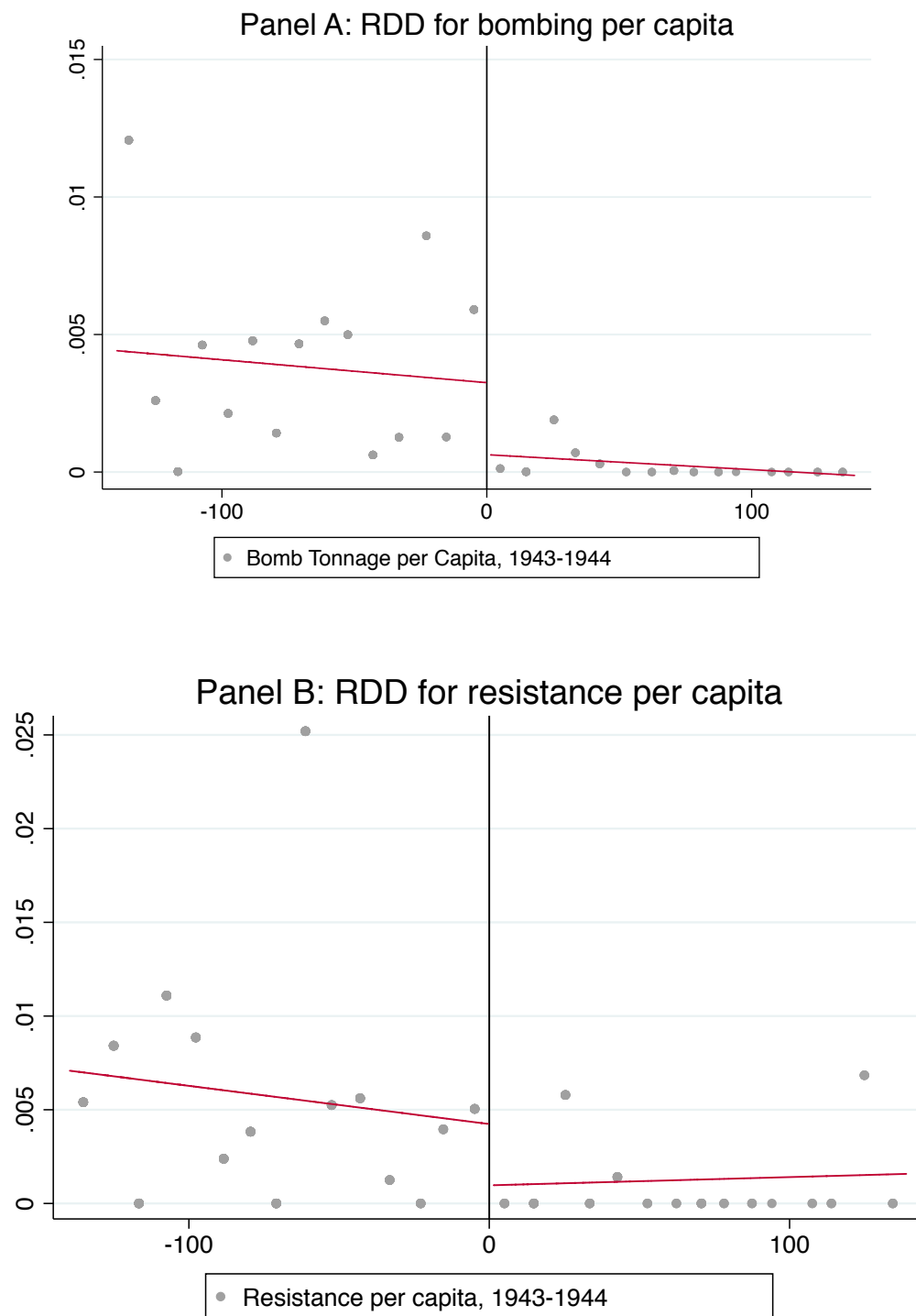


Figure A. 7: Timing of First Bombing – Home Town of Pilots

HOME CITIES OF PILOTS BOMBED

number of pilots affected

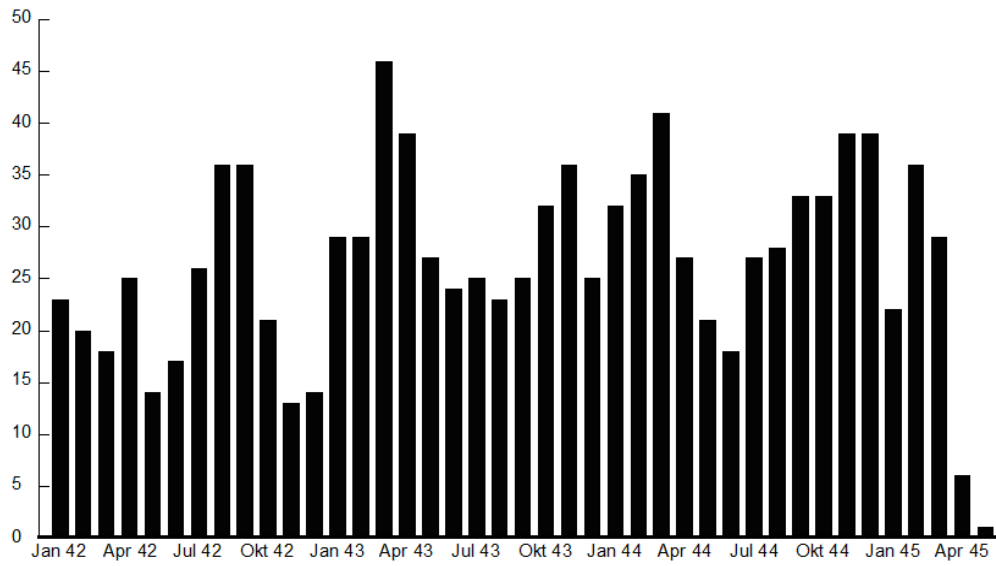
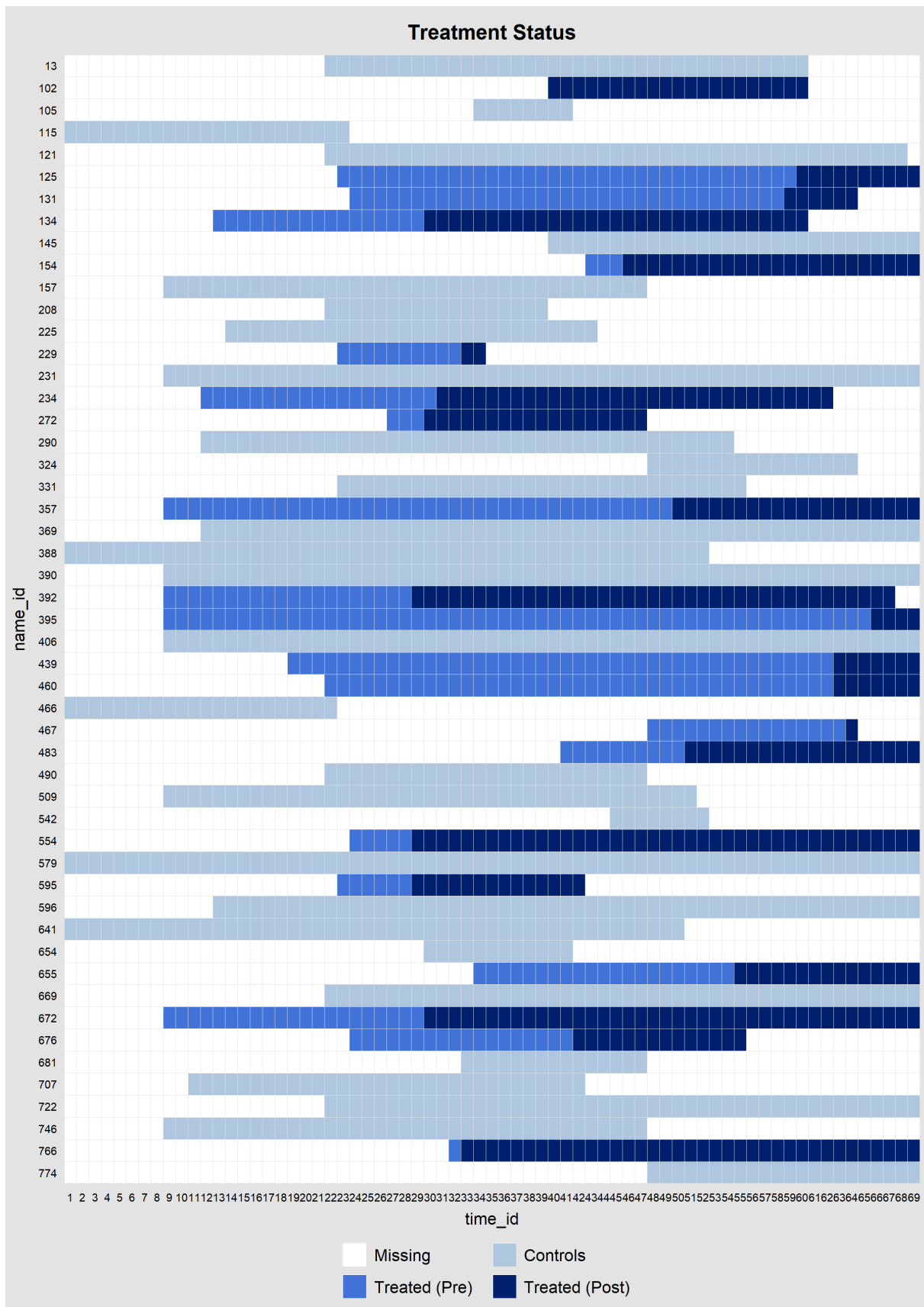
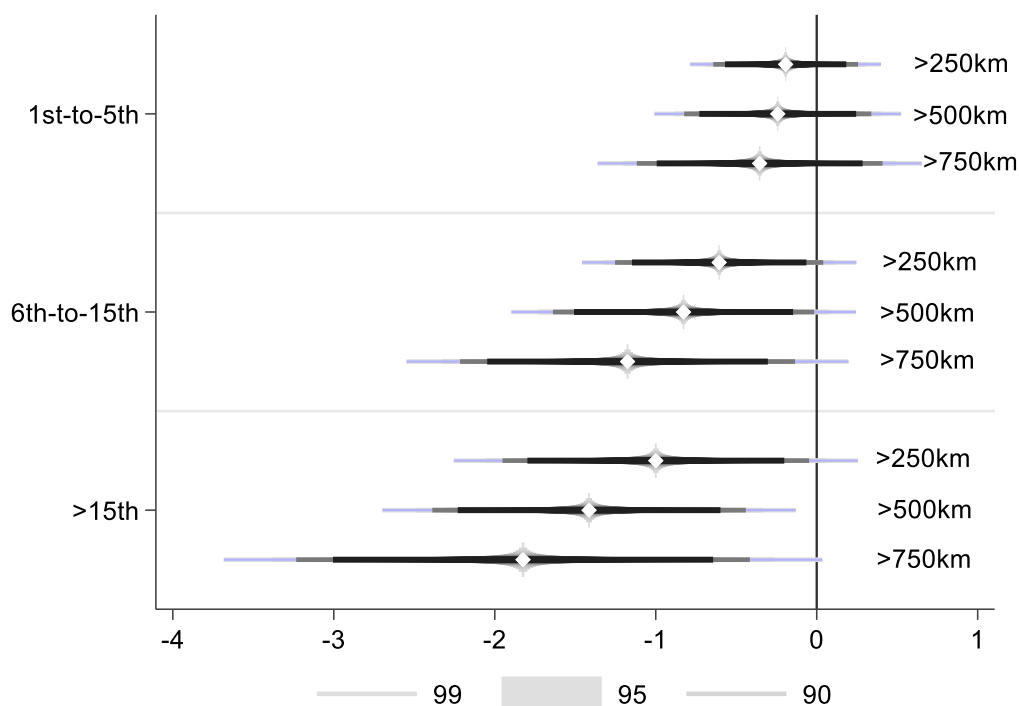


Figure A. 8: Unbalanced sample – fighter pilots.



Note: The figure shows, for a subset of the pilots in our dataset, the evolution of treatment status – pre-periods for treated(blue), treated period (black), potential control units (gray) that are not treated, and missing data (white).

Figure A. 9: Effect of Bombing on Fighter Pilot Performance, by Distance to Home Town



Note: The figure plots the coefficients from three separate regressions, with a pilot's monthly victory rate on the left-hand side. The bars show coefficient for three "home town attacked" dummies, coded separately to distinguish the 1st-5th attack from that of the 6th-15th and the 16th and further attacks. The excluded category is no-attack. We include individual pilot fixed effects and cluster at the pilot-month level. We restrict the sample to a) pilots flying from airfield more than 250 km from their home town, b) more than 500 km, and c) more than 750 km. The blue bar shows the error band for 99% significance; the thinnest black bar, for 95%; and the thick black one, for 90% significance. The regression equivalent is reported in Table A.8.

Table A.1: Summary Statistics.**Panel A. Daily Analysis Variables.**

	N	min	Mean	Median	max	St.Dev
Daily Bombing Tonnage	684216	0	1.14	0	10449.04	41.836
Distance from London	684216	434.074	725.256	718.107	1166.435	161.159
Average Wind	684216	1.039	3.714	3.295	14.033	1.835

Panel B. Monthly Panel Variables.

	N	min	Mean	Median	max	St.Dev
Log (1+ # of arrests)	22464	0	.011	0	4.543	.128
Log (1+ # of new resistance cases)	22464	0	.008	0	3.526	.107
Monthly bombing, predicted from weather	22464	0	1.018	1.05	1.211	.12
At least one new resistance case	22464	0	.008	0	1	.09
Log(mean monthly bombing)	22464	0	.109	0	6.48	.56

Panel C. Fighter Pilots

	N	min	Mean	Median	max	St.Dev
Eastern Front	13983	0	.516	1	1	.5
Experience	13983	1	23.515	21	69	15.843
Victory	13983	0	1.94	0	68	4.3
Hometown Bombed	13983	0	.165	0	1	.372

Panel D. RDD

	N	min	Mean	Median	max	St.Dev
Distance from East Anglia	1024	414.998	792.534	772.449	1509.832	214.452
Within range	1024	0	.854	1	1	.353
Log (New Resistance Cases), avg	1024	-.008	0	-.008	1.869	.066
Log (monthly bombing), avg	1024	0	.278	0	6.225	.631

Panel E. Cross Sectional variables.

	N	min	Mean	Median	max	St.Dev
Log (Population), 1938	920	8.236	10.945	10.901	15.208	.724
Nazi vote share, 1933	876	13.293	44.859	44.454	83.006	12.465
SPD vote share, 1933	876	.011	.162	.157	.464	.091
KPD vote share, 1933	876	.002	.09	.076	.36	.062
Turnout, 1933	876	72.064	88.888	89.389	96.039	3.241
Welfare recipients, 1932	907	3.5	25.754	23.4	93.9	14.491
Social Renters per capita, 1932	907	1.043	8.83	7.932	33	5.035
Log (Property Tax), 1930	894	2.805	6.311	6.45	8.446	.761
Log (New Resistance Cases)	936	0	.007	0	1.558	.056
BBC Signal Availability	936	-1.341	-.165	-.116	-.08	.115
German Radio Availability	936	.052	.27	.26	.75	.104

Panel F. USSBS Variables

	N	min	Mean	Median	max	St.Dev
Gender	3579	0	.611	1	1	.488
Age	3579	1	6.845	7	101	8.123
Married	3578	0	.711	1	1	.453
HighSchool	3561	0	.226	0	1	.418
Listened to Radio London	2282	0	.393	0	1	.488
Listened to Allies	2282	0	.501	1	1	.5
Perceived Bias in German Sources	1291	0	.125	0	1	.331

Table A.2: RDD and Different Thresholds.

Threshold:	Log (New Resistance Cases)						
	Fuzzy RDD						
	140 km (1)	160 km (2)	180 km (3)	200 km (4)	220 km (5)	240 km (6)	260 km (7)
Log (Bombing), average	0.151** [0.069]	0.190** [0.086]	0.187** [0.075]	0.191*** [0.070]	0.165*** [0.056]	0.182*** [0.066]	0.174*** [0.059]
Observations	280	329	376	429	478	528	565

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Fuzzy RDD is estimated as an IV with distance to the max operational range (985 km) as the running variable. Similar results for the optimal bandwidth of 201 km (Imbens and Kalyanamaran, 2012), are reported in Table 2, column 3. Linear distance terms on both sides of discontinuity are included, but not reported. Resistance is the average residual of the log of monthly beginning resistance activity (+1) on month dummies.

Table A.3: RDD, Other variables, and Different Thresholds.

Bandwidth:	Coefficients for RDD for different bandwidths for other variables						
	Sharp RDD						
	140 km (1)	160 km (2)	180 km (3)	200 km (4)	220 km (5)	240 km (6)	260 km (7)
Log (Population)	0.324 [0.203]	0.267 [0.188]	0.277 [0.178]	0.289* [0.172]	0.220 [0.166]	0.121 [0.158]	0.133 [0.156]
Nazi (NSDAP) Vote Share, 1933	-3.540 [2.740]	-4.305* [2.572]	-4.338* [2.485]	-5.995** [2.339]	-6.282*** [2.309]	-6.280*** [2.167]	-5.757*** [2.150]
Communists (KPD) Vote Share, 1933	0.002 [0.013]	0.006 [0.012]	0.010 [0.012]	0.017 [0.011]	0.013 [0.010]	0.010 [0.010]	0.012 [0.010]
SPD Vote Share, 1933	0.014 [0.023]	0.003 [0.022]	0.015 [0.020]	0.023 [0.019]	0.022 [0.018]	0.025 [0.017]	0.028* [0.017]
Turnout, 1933	0.344 [1.333]	0.557 [1.225]	0.738 [1.180]	0.619 [1.102]	1.376 [1.085]	1.783* [1.021]	2.269** [1.010]
Welfare Recipients, 1933	2.987 [4.311]	2.669 [3.993]	3.333 [3.790]	3.846 [3.617]	2.791 [3.497]	2.767 [3.363]	3.265 [3.301]
Social renters, 1933	1.327 [1.319]	1.119 [1.216]	1.596 [1.154]	1.896* [1.078]	1.591 [1.041]	1.592 [1.004]	1.821* [0.977]
Property Tax, 1930	0.144 [0.197]	0.144 [0.182]	0.106 [0.175]	0.195 [0.165]	0.215 [0.159]	0.194 [0.150]	0.230 [0.149]
Observations	280	329	376	429	478	528	565

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Each cell represents the result of a separate regression with a variable from the left used as a dependent variable and different bandwidths from above used. Sharp RDD is estimated as an IV with distance to the max operational range (985 km) as the running variable. Linear distance terms on both sides of discontinuity are included. Each cell reports the results of a separate regression with the dependent variable from the left column using threshold indicated above.

Table A.4: RDD and exclusion of some locations/groups of locations.

Bandwidth:	Sharp RDD						
	Donut specification, excluding				Excluding nearby large cities		
	20km around	40km around	60km around	80km around	Excluding	Excluding	Excluding
	circle	circle	circle	circle	Munich	Berlin	Berlin+Munich
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log (Bombing), average	0.223** [0.103]	0.241** [0.106]	0.360** [0.151]	0.294*** [0.086]	0.231*** [0.085]	0.147** [0.072]	0.189* [0.109]
Observations	395	360	324	282	428	428	427

Note: Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1. Fuzzy RDD is estimated as an IV with distance to the max operational range (985 km) as the running variable. Optimal bandwidth of 201 km (Imbens and Kalyanamaran, 2012) is used. Baseline results are reported in Table 2, column 3. Linear distance terms on both sides of discontinuity are included, but not reported. Resistance is the average residual of the log of monthly beginning resistance activity (+1) on month dummies.

Table A.5: Bombing (Predicted by Weather) and Resistance. Conley standard errors.

	Log(New Resistance Cases)		At least 1 new resistance case (dummy)	
	(1)	(2)	(3)	(4)
Predicted Bombing	0.048** [0.022]	0.049** [0.021]	0.038* [0.022]	0.038* [0.022]
Log (Arrests)		-0.032 [0.034]		-0.000 [0.021]
City Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Observations	22,464	22,464	22,464	22,464
R-squared	0.393	0.394	0.186	0.186

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1.

Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

Table A.6: Bombing and New Resistance Cases. OLS Estimates.

	Log(New Resistance Cases)		At least 1 new resistance case (dummy)	
	(1)	(2)	(3)	(4)
Predicted Bombing	-0.001 [0.004]	-0.002 [0.004]	-0.004 [0.003]	-0.004 [0.003]
Log (Arrests)		-0.032 [0.032]		-0.001 [0.025]
City Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Observations	22,464	22,464	22,464	22,464
R-squared	0.393	0.394	0.187	0.187

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1.

Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

Table A.7: Bombing, Predicted from Weather, Resistance, and Predispositions.

	Log(New Resistance Cases)		At least 1 new resistance case (dummy)	
	(1)	(2)	(3)	(4)
Predicted Bombing	0.060** [0.022]	0.050** [0.018]	0.047** [0.019]	0.053** [0.024]
Predicted Bombing x NSDAP Vote share in 1928	-0.005 [0.003]		-0.004 [0.003]	
Predicted Bombing x Pogroms in 1349		0.009 [0.032]		0.001 [0.047]
City Fixed Effects	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes
Observations	22,032	8,928	22,032	8,928
R-squared	0.403	0.131	0.187	0.135

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1. Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944. Columns 2 and 4 only include places that existed in 1349.

Table A.8: Bombing at Home and Pilot Motivation. Double Clustering.

	Number of enemy planes shot down				
	(1)	(2)	(3)	(4)	(5)
Hometown Bombed	-0.175*	-0.572***	-0.472**	-0.437*	-0.422*
	[0.094]	[0.212]	[0.204]	[0.25]	[0.251]
Experience	-0.009***	0.0117***			
	[0.002]	[0.0040]			
Eastern Front dummy	1.690***	1.841***	1.425***	1.250***	1.258***
	[0.070]	[0.137]	[0.162]	[0.175]	[0.178]
Pilot Fixed Effects		Yes	Yes	Yes	Yes
Time Fixed Effects			Yes	Yes	Yes
Squadron Fixed Effects				Yes	Yes
Aircraft Fixed Effects					Yes
Mean of Dependent Variable	1.94	1.94	1.94	1.94	1.94
Observations	13983	13983	13983	13957	13957
R-squared	0.041	0.137	0.205	0.233	0.235

Robust standard errors, clustered by pilot and month, in brackets. *** p<0.01, ** p<0.05, * p<0.1. Unit of observation is pilot-month. Exponentiated coefficients from Cox regressions in Panel B. Exit is defined as KIA or severely wounded.

Table A.9: Bombing at Home and Pilot Motivation.

	(1)	(2)	(3)	(4)
	all	>250km	>500km	>750km
1 st -to-5 th	-0.372*	-0.193	-0.242	-0.354
	(0.193)	(0.228)	(0.295)	(0.387)
6 th -to-15 th	-0.591**	-0.606*	-0.827**	-1.175**
	(0.300)	(0.328)	(0.412)	(0.527)
16 th +	-0.911**	-0.999**	-1.414***	-1.824**
	(0.391)	(0.483)	(0.494)	(0.714)
front	1.418***	1.516***	1.859***	2.165***
	(0.166)	(0.185)	(0.209)	(0.243)
N	13815	11459	9232	7084
R ²	0.205	0.214	0.223	0.239

Note: The regression reports coefficients for the change in monthly victory rates of pilots, by order of attack on their home towns and distance from home town to pilot's airfield. Standard errors in parentheses.

* p < .1, ** p < .05, *** p < .01

Table A.10: BBC Availability vs Survey Demographics.

	Gender	Age	High School education	Protestant
	(1)	(2)	(3)	(4)
BBC Radio Availability	-0.068 [0.196]	2.091 [1.818]	-0.276 [0.287]	-0.462 [1.138]
Observations	3,579	3,579	3,561	3,573
R-squared	0.000	0.000	0.001	0.003

Robust standard errors in brackets, clustered by city. *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX B: BOMBING AND THE GEOGRAPHY OF RESISTANCE IN BERLIN

As the capital of Germany, Berlin was a prime target for allied bombers throughout the war. Bomber Command's CiC, Arthur Harries, sought to destroy the city during the so-called "Battle of Berlin" (Nov 1943 to Mar 1944), ordering 16 massive raids. Bomber Command dispatched reconnaissance planes after every major raid, taking detailed aerial photographs. These were then used to compile destruction maps of major German cities. Cartographers hand-colored every destroyed building in blue in large transparent overlays of enlarged city maps. The collected damage assessments were collected in the so-called "Blue Books".¹ Contemporary newspaper articles show the head of Bomber Command, Arthur Harris, examining the damage maps under the headline "The Brain Behind the Death of Berlin Look at His Work from Afar" (Figure B.1).

Some of the maps contained in the Blue Books have survived the war. We digitize the one for Berlin, compiled in March 1945 (Figure B.2), and combine it with precise geo-referenced information on the location of resistance activity. Did areas that suffered from more aerial bombardment within Berlin witness more resistance against the regime?² Data from March 1945 is useful for our purposes since the massive destruction during the capture of Berlin by Soviet troops in April 1945 had not yet occurred—effectively all documented damage is the result of aerial bombardment.

We use a finely-grained grid of 1,479 cells, corresponding to about 0.5km² each. We can assign 130 resistance cases to the part of the Berlin map covered by the Blue Book. A first impression of the nature of the data can be gleaned from Figure B.3, which shows a bin-scatter of the number of resistance cases against the (log) of bomb damage in a grid-cell: more resistance occurred where the bomb damage was the heaviest in Berlin. Nonetheless, it may well have been the case that district characteristics interacted with bombing volume (i.e. there might have been more bombing in workers' districts where more industrial plants were located, and where sympathy for the Nazis was lower to start with).

¹ Analysts examined hundred of photographs taken after each air raids. They evaluated details like the shadow of a house to determine whether the roof had burned down.

² Unfortunately, there are no earlier damage maps that would allow us to assess changes over time.

To deal with this issue, we exploit variation over time in bombing and resistance. Since we do not have panel data on the destruction of different neighborhoods of Berlin, we construct a time-varying measure of destruction of different neighborhoods by interacting the level of destruction of a particular grid cell in March 1945 with the monthly bombing volume for the whole Berlin.³

Table B.1 reports the results. New resistance was more likely to occur in the months following intense bombing, with the difference between most heavily bombed grid cell and least heavily bombed grid cell leading to 1.8% more resistance cases at the mean value of bombing and 2.5% higher probability of having at least one resistance case at the grid cell-month level.⁴ Overall, these results confirm our previous findings that bombing furthered resistance activity.

Table B. 1: Damage from Bombing and Resistance in Berlin

	Log (1+Resistance Cases)		At Least One New Resistance	
	(1)	(2)	(3)	(4)
Log (Bombing of Berlin)*Final Damage to Grid Cell	0.0002** [0.0001]	0.0002** [0.0001]	0.0003* [0.0001]	0.0003* [0.0001]
Log (Bombing of Berlin)	0.0007 [0.0004]	-0.0002 [0.0006]	0.0008 [0.0005]	-0.0003 [0.0005]
Grid Cell Fixed Effects	Yes	Yes	Yes	Yes
Quarter Fixed Effects		Yes		Yes
Observations	10,353	10,353	10,353	10,353
Number of grid cells	1,479	1,479	1,479	1,479

Note: Robust standard errors, clustered by gridcell and quarter, in brackets. *** p<0.01, ** p<0.05, * p<0.1.

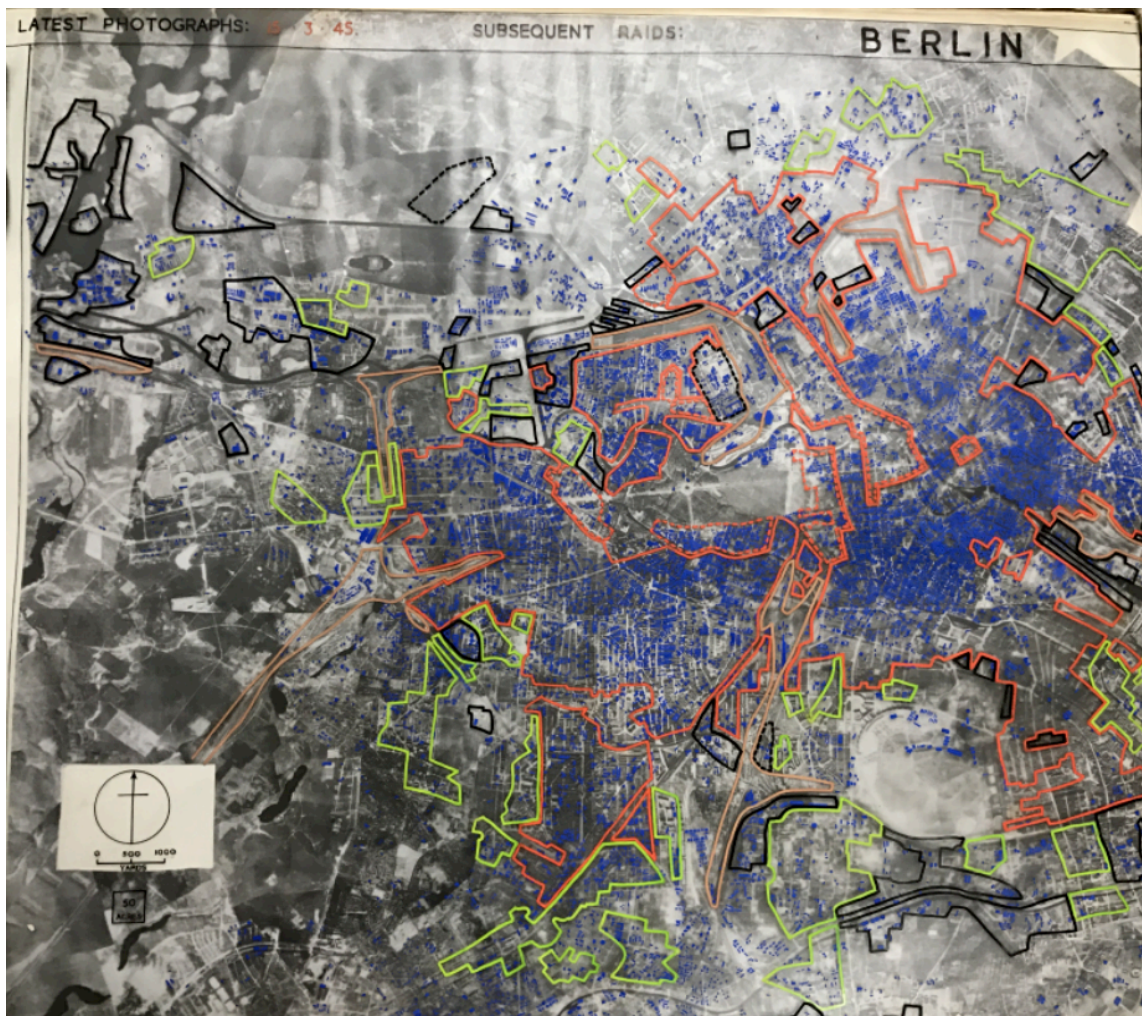
³ This approach is similar to the shift-share instrument used in the study labor demand shocks (Bartick 1991), import penetration (Autor, Dorn, and Hanson (2013), or immigration (Dustman, Schönberg, and Jan Stuhler 2017).

⁴ To get these numbers, we multiply the coefficient of interest for the interaction term by the difference in log total damage between most bombed and least bombed district and by the number of quarters since the beginning of 1943 till the end of the war.

Figure B. 1: Sir Arthur C. Harris and the Destruction of Berlin

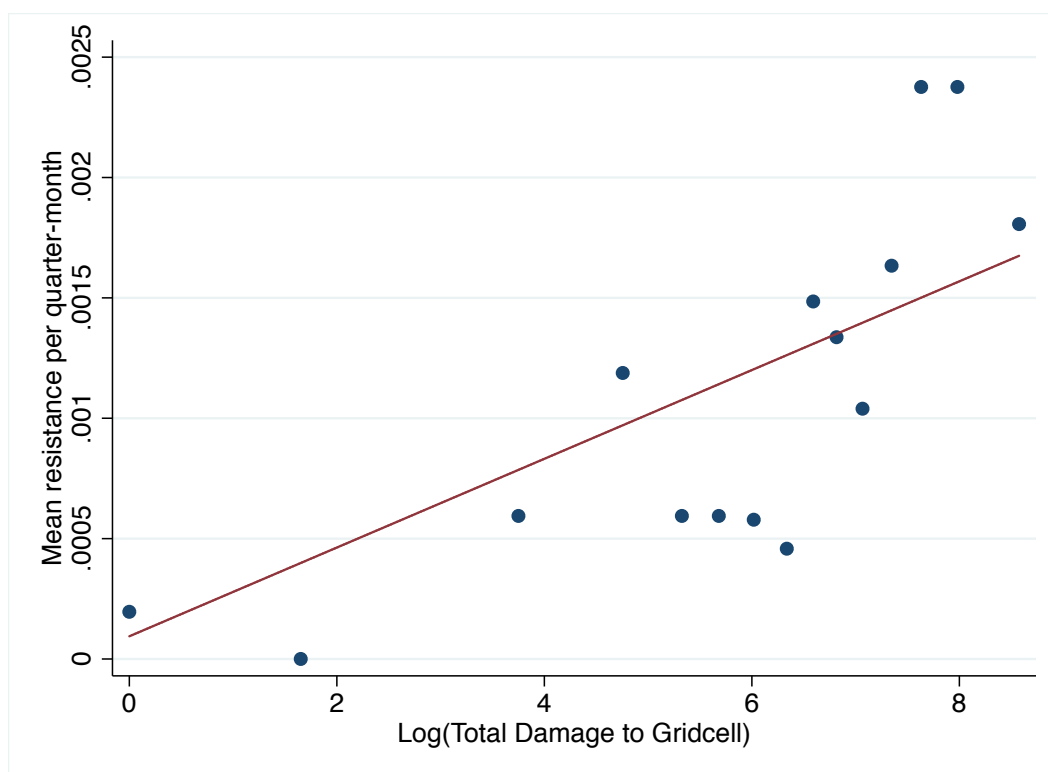


Figure B. 2: Berlin Damage Map from the „Blue Book“ (March 1945).



Notes: Blue areas – destroyed or badly damaged; red contours: fully built-up residential areas; black contours: industrial areas; green: 40-70% residential. Source: Imperial War Museum.

Figure B. 1.: Bombing of grid cells and average resistance in Berlin sample.



APPENDIX C: RESISTANCE, ARRESTS AND THE TIMING OF GESTAPO

ACTIVITY

In Table C.1 below, as recommended by Angrist and Pischke (2009) we examine lags and leads to see whether there is any evidence of pre-trends in terms of arrests. To this end, this table reports coefficients for bombing either 1 or 2 months before/after an actual attack. We do not observe a significant impact of bombing on contemporary arrests or for arrests 1 or 2 months earlier. There is, however, some evidence that Gestapo arrests followed bombing attacks with a lag of one month (column 4), suggesting that 100% increase in bombing led to a 7.9% increase in arrests one month later. The rapid uptick in arrests implies that only a short time often passed between the beginning of resistance and arrest, in line with historical accounts underlining the ruthless efficiency of the Gestapo.¹

Table C.1. Bombing, predicted from Weather, and Arrests. Pre- and post- trends.

	Log(New Arrests)				
Log (Bombing), 2 months later	0.029				
	[0.046]				
Log (Bombing), 1 month later		0.019			
		[0.054]			
Log (Bombing), same month			0.043		
			[0.056]		
Log (Bombing), 1 month earlier				0.079*	
				[0.042]	
Log (Bombing), 2 months earlier					0.054
					[0.036]
City Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	22,464	22,464	22,464	21,528	19,656

Note: Robust standard errors in brackets, clustered by city and month. *** p<0.01, ** p<0.05, * p<0.1.

Bombing is predicted from average wind, interacted with distance to London and its square, at the daily level and then aggregated to the monthly level. Time period is 1943-1944.

¹ The distribution of time to arrest is shown in Figure 2 of the main text.

APPENDIX D: BBC, BOMBING, AND PUBLIC OPINION – EVIDENCE FROM THE USBSS

The USBSS

We first use newly digitized data from the survey responses of 4,309 Germans interviewed by Allied investigators immediately after the end of World War II. Members of the staff of the USSBS carried out detailed interviews of the civilian population in bombed cities. This offers an opportunity to study public opinion about the war right after its end. Among other questions, USSBS survey asked the respondents when they started to listen to BBC (see Figure D.1 for the distribution of these answers). This allows us to relate some opinion questions to the timing of starting to listen to the BBC in a panel framework, controlling for individual fixed effects. Table D.1 reports these results. Panel A shows that the earlier people started listening to the BBC, the earlier they held the (self-reported) belief that the war was lost. There are no associated pre-trends. Similarly, Panel B shows a positive correlation between wanting the war to end beginning to listen to BBC. While these results are based on self-reported responses on timing, and need be interpreted with caution, they suggest that the BBC German service was associated with greater pessimism about the war among the German populace.

However, we do not have a good source of exogenous variation to study the causal impact of bombing using this data: our survey cities (shown on the map in Figure D.2) were not sufficiently close to maximum B-17 bombing range to use the bombing range discontinuity, and the weather instrument is not informative in the cross section. Nonetheless, we can analyze basic patterns in the data, as presented in Figure D.3.

In cities that were bombed more by the Allies, respondents report a higher frequency of air raids -- providing some external validation for our bombing measure (Panels A and B of Figure D.3). Moreover, there some suggestive evidence that respondents who experienced more bombing reported low overall levels of morale and were more likely to report passive

attitudes towards Nazis (Panels C and D of Figure D.3).¹ These results are broadly consistent with the results for bombing as reported in section 4 of the main text.

Radio's Effect

Did wartime exposure to the BBC affect people's opinions more generally? In Panel A of Table D.2, we instrument BBC listening with our city level measure of BBC signal availability. Essentially, the results from Table 7 (column 4) constitute the first stage of this estimation. These results are computed with the help of weak instrument robust confidence sets (Andrews 2017, Sun 2018), which are reported in the separate row under their coefficients. We find that, on average, people listened to Allied radio were more likely to think that the war was lost because of shortages or superior Allied air power (+29% and +31% in probability of agreeing). They also assessed the occupation experience more favorably (+94%). In Panel B of Table D.2, we report the results for bombing and BBC together, using OLS estimation.² Consistent with our panel data results, listening in places where Allied radio reception was good and where the Allied bombed, respondents were more likely to state that the war was lost because of shortages or superior Allied air power, that the war was lost from the beginning, and they had passive attitudes towards Nazis.

While self-reported attitudes after the end of World War II are not necessarily compelling evidence in favor of the effects of broadcasts and air power, we note that around 40% of respondents self-identified as Nazi supporters; this suggests that social desirability bias did not entirely distort survey responses.

¹ The morale index was constructed from 12 different subcomponents by USSBS survey personnel; it was intended to measure the level of ordinary people's morale at the end of the war.

² Unfortunately, we cannot estimate this specification using IV, for two reasons. First, our weather instrument only works for short term fluctuations in bombing rather than for aggregate volumes. Second, in the specification with interactions, signal strength becomes a very weak predictor of self-reported exposure to BBC, with weak instrument robust confidence sets covering entire grid.

Figure D.1: Listening habits to Allied broadcasts, reported by USSBS respondents.

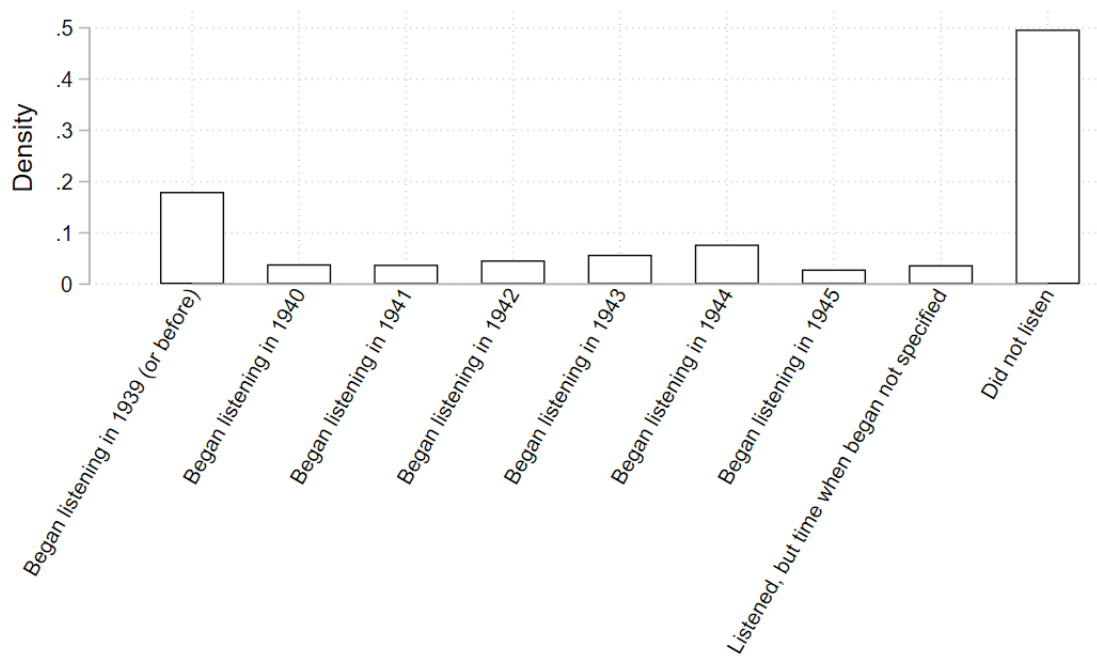


Figure D.2: Cities surveyed by the USSBS.

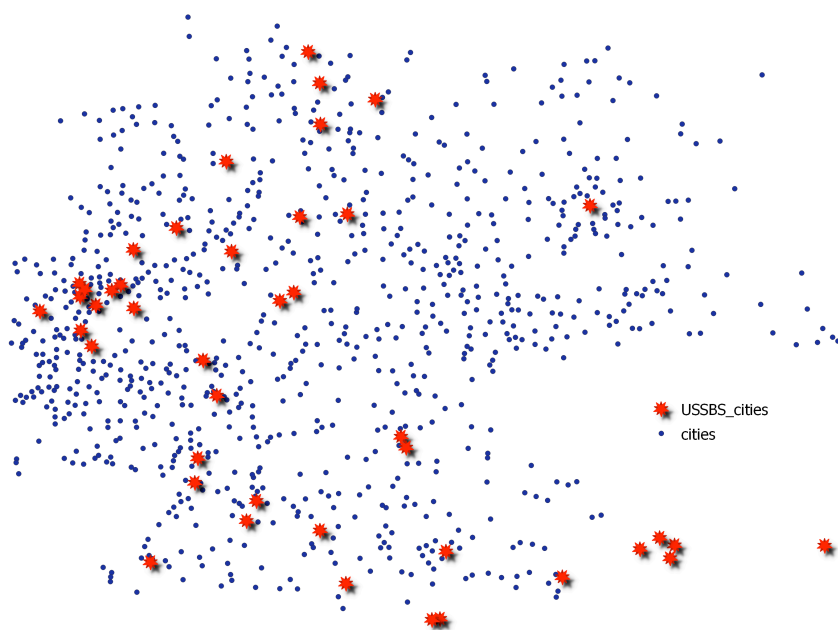
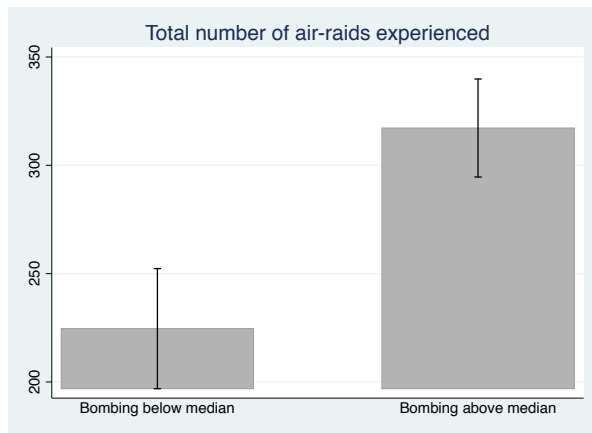
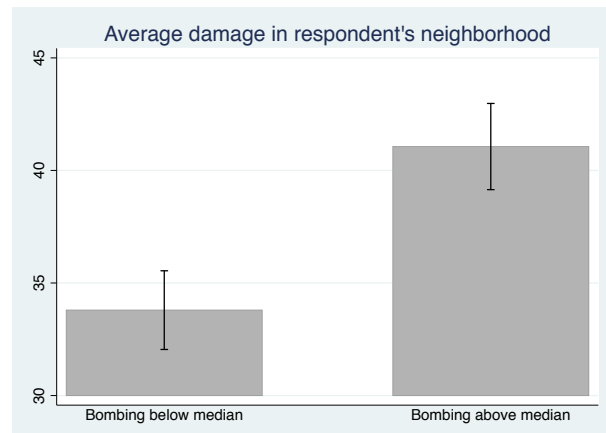


Figure D.3: Bombing and USSBS survey data.

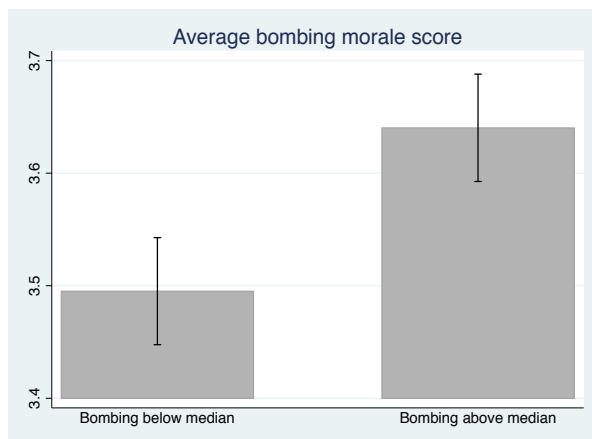
A. Bombing and (self-reported) air raids.



B. Bombing and (self-reported) neighborhood destruction



C. Bombing and Bombing Morale Score (higher value indicates lower morale)



D. Bombing and attitudes to Nazis (passive acceptance, indifference, ignorance)

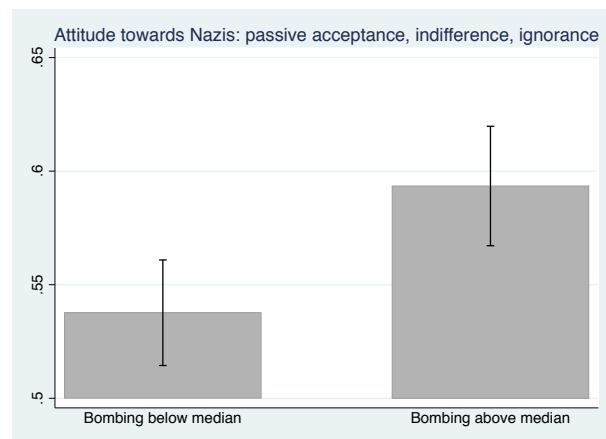


Table D.1: Public Opinion in 1945 and Exposure to BBC. Panel Results.

Panel A. Thought war was lost		When did you first think that the war was lost?			
	(1)	(2)	(3)	(4)	(5)
Started to Listen to BBC, 2 months before	-0.002 [0.022]				
Started to Listen to BBC, 1 month before		0.010 [0.017]			
Started to Listen to BBC			0.095*** [0.015]		
Started to Listen to BBC, 1 month after				0.058*** [0.016]	
Started to Listen to BBC, 2 months after					0.037*** [0.012]
Respondent Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	6,795	9,060	11,325	9,060	6,795
Number of respondents	2,265	2,265	2,265	2,265	2,265
Panel B. Wanted the war over		When did you first want the war to be over?			
	(1)	(2)	(3)	(4)	(5)
Started to Listen to BBC, 2 months before	-0.014 [0.016]				
Started to Listen to BBC, 1 month before		-0.019 [0.016]			
Started to Listen to BBC			0.093*** [0.014]		
Started to Listen to BBC, 1 month after				0.005 [0.011]	
Started to Listen to BBC, 2 months after					0.021 [0.014]
Respondent Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	6,501	8,668	10,835	8,668	6,501
Number of respondents	2,167	2,167	2,167	2,167	2,167
Robust standard errors, clustered by city, in brackets. *** p<0.01, ** p<0.05, * p<0.1					

Table D.2: Public Opinion in 1945, Exposure to BBC, and Bombing.

Panel A. BBC and Opinions. 2SLS.	Reason lost war: Shortages (1)	Reason lost war: Allies Air Power (2)	Reason lost war: Bad Leadership by Nazis (3)	Thought War is Lost from the Beginning (4)	Attitude to Nazis: Passive (5)	Satisfaction with occupation: favorable (6)	Satisfaction with occupation: unfavorable (7)
Listened to Allied radio	0.290*** [0.182]	0.313*** [0.180]	-0.245 [0.320]	0.203 [0.229]	-0.012 [0.281]	0.942*** [0.327]	-0.259* [0.134]
Weak Instrument Robust 95% Confidence Sets	[.055; .958]	[.046; .901]	[-1.164; .294]	[-.272; .724]	[-.819; .461]	[.327; 1.815]	[-.564; .046]
Olea-Montiel and Pflueger Effective F-statistics	13.853	13.853	13.853	13.967	13.682	13.809	13.809
Observations	2,253	2,253	2,253	2,255	2,255	2,256	2,256
Number of cities	34	34	34	34	34	34	34
Panel B. BBC, Bombing, and Opinions. OLS	Reason lost war: Shortages (1)	Reason lost war: Allies Air Power (2)	Reason lost war: Bad Leadership by Nazis (3)	Thought War is Lost from the Beginning (4)	Attitude to Nazis: Passive (5)	Satisfaction with occupation: favorable (6)	Satisfaction with occupation: unfavorable (7)
Listened to Allied radio x Bombing Tonnage	0.002** [0.001]	0.002** [0.001]	-0.002 [0.002]	0.003*** [0.001]	0.003* [0.002]	0.000 [0.001]	-0.000 [0.000]
Listened to Allied radio	-0.049*** [0.016]	-0.038** [0.018]	0.092*** [0.016]	0.039* [0.022]	0.121*** [0.034]	0.039 [0.024]	-0.038*** [0.011]
Bombing Tonnage	-0.001* [0.001]	-0.001** [0.001]	0.001 [0.001]	-0.002** [0.001]	0.000 [0.002]	0.003*** [0.001]	-0.001 [0.001]
Observations	2,253	2,253	2,253	2,255	2,255	2,256	2,256
Number of cities	34	34	34	34	34	34	34

Robust standard errors, clustered by city, in brackets. *** p<0.01, ** p<0.05, * p<0.1. In Panel A, levels of significance are reported based on weak instrument robust confidence sets. In Panel B, weak instrument robust confidence sets do not consist of a single limited interval, thus we are only able to compute OLS estimates.

Table D.3: Demographics in USSBS cities and BBC Radio Availability. Placebo test.

	Gender	Age	High School education	Protestant
	(1)	(2)	(3)	(4)
BBC Radio Availability	-0.068 [0.196]	2.091 [1.818]	-0.276 [0.287]	-0.462 [1.138]
Observations	3,579	3,579	3,561	3,573
R-squared	0.000	0.000	0.001	0.003

Robust standard errors in brackets, clustered by city. *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX E: RESISTANCE SAMPLE

The full sample consists of 1,944 individuals, 15,5% of them female. Of those, whose trial was completed before the end of WWII (1607 individuals) 44,2% received death penalty (but only 26% of females), 39% received a penalty of 6,3 year on average of work camp (plus were dishonored for usually the same duration), 8,5% were sentenced to, on average, 2.2 years in prison, and 8,2% were found not guilty. 24.8% had some previous criminal records. The graph below shows the correlations between having a criminal record, the type of accusation, and the sentence. The duration of resistance is on average, 15 months. The time lag between the end of resistance and accusation is, on average 295 days, but it is skewed. Only 25% were accused within of 103 days, 50% within of 222, and 75% within of 390 days. The average time lag between the accusation and sentence was 72 days.

Table E. 1: Summary statistics for the resistance sample

	coun t	mean	sd	min	max
female	1944	0.155	0.362	0	1
criminal record	1944	0.248	0.432	0	1
acc. of high treason	1944	0.931	0.254	0	1
acc. of undermining defensive capability	1944	0.167	0.373	0	1
acc. of aiding the enemy	1944	0.509	0.500	0	1
acc. of failure to disclose	1944	0.103	0.304	0	1
sentenced	1607	1.000	0.000	1	1
death penalty	1944	0.366	0.482	0	1
work camp dummy	1607	0.390	0.488	0	1
duration work camp	627	6.308	3.068	1	15
prison dummy	1607	0.085	0.278	0	1
duration prison	136	2.224	1.539	3	10
dishonor dummy	1607	0.381	0.486	0	1
acquitted of a charge	1944	0.068	0.252	0	1
difference between resistance and accusation in days	1515	295.03	307.52	6	375
difference between accusation and conviction in days	1324	71.850	50.901	0	455
duration of resistance in months	1533	15.116	18.573	0	134
Observations	1944				

Figure E. 1 Correlations in the resistance sample

criminal record									
0.045	high treason								
0.090	0.101	subversion of the war effort							
0.069	0.181	0.203	acc. of aiding the enemy						
-0.058	-0.534	-0.124	-0.203	acc. of failure to disclose					
0.110	0.182	0.158	0.267	-0.229	death penalty				
-0.073	0.033	-0.150	-0.199	0.009	-0.524	work camp			
-0.055	-0.179	-0.080	-0.102	0.325	-0.208	-0.189	prison		
-0.072	0.028	-0.146	-0.194	0.007	-0.515	0.980	-0.186	dishonor	
-0.042	-0.103	-0.077	-0.128	0.124	-0.205	-0.186	-0.074	-0.183	acquitted of a charge

Example cases (short summary) as provided by the accusation and sentence documents:

Berndhard K., a former lieutenant-colonel. Since the turn of the year 1943/44, he received hints about a planned assassination by his superior Stieff. In May 1944, he brought explosives for the planned Hitler assassination to Berlin and continued to participate in preparations for the assassination attempt. He was kept up to date by Stauffenberg. Place of living: Zossen; Place of crime: Berlin; Resistance start: May 1944; Resistance end: July 1944; Date of accusation: August 1944; Date of court decision August 1944; He received death penalty

Otto W. was a councilor at the police headquarters in Berlin before being drafted into the military. In March 1943 he allegedly wrote (but never sent) a letter addressed directly to the Fuhrer in which he asked for the Fuhrer's resignation so to stop the ongoing war. He wrote another note titled "Mission to Save Germany" addressed to known military men as well as important public figures. There, he called for peace negotiations with the Allies (Great Britain and USA) in order to overthrow the German government in a joint effort. He also tried to convince several high-ranking military officials to stage a coup against the Hitler regime. W. was arrested at the Swiss border in September 1943, when he attempted to flee. He was sentenced to death by the military court on 14 February 1944.

Adam von T. was a co-conspirator of the Stauffenberg-assassination plot of 20 July 1944. Beginning in 1940 von T. used his position at the Federal Foreign Office in Berlin to get access to insider information and in order to participate in official business trips to foreign countries. Over time he established an extensive network of regime opposing military personnel and private citizens inside and outside of Germany. Closer to the planned assassination he attempted to make contact with the Allies so as to gain their support for the coming coup. von T. was also a member of the Kreisau Circle. The main objective of this group was to plan the restructuring of the government after the fall of the fascist regime. One of his last acts was to visit the exiled socialist Willy B. in Stockholm whom he approached concerning a government position in a post-Hitler era. After the failed coup the people's court sentenced him to death on 15 August 1944.

The siblings **Hans and Sophia S.** were part of the student resistance group White Rose which originated at the University of Munich. After returning from the Eastern Front in the summer of 1942 Hans S. composed several leaflets in which he criticized the fascist ideology and reported on atrocities committed by the German regime, e.g. the mass murder of Jews. While Hans returned to the front, Sophia learned of her brother's involvement in the activities of the White Rose and following Hans return in January 1943 she helped to produce and distribute 6000 to 9000 copies of the leaflet "Appeal to All Germans". Most of the leaflets were mailed to University employees and students. Additionally, Hans put anti-fascist slogans ("Down with Hitler") and crossed-out Swastikas on walls of prominent Munich buildings like the University, National Theater, Ministry of Commerce and the Festival Theater. Hans and Sophie S. as well as other members of the White Rose were arrested on 18 February 1943 and sentenced to the death by the people's court on 22 February 1943. Place of living: Munich; Place of crime: Munich, Augsburg, Salzburg, Wien, Stuttgart; Start of resistance: Juni 1942, End of resistance: February 1943.

Robert H., Georg G., Herbert R. and Paul R. met regularly in Berlin to discuss the political situation and recent military developments. At a meeting in July 1943 the group of academics (chemist, doctor, architect and dentist) agreed that they needed to take measures as Germany was about to lose the war. Hence, they founded a resistance organization "European Union". The organization's manifest—"Answer to all Fascists"—embraced communist and democratic ideology while at the same time condemning the Fuhrer and his fascist regime. The four members became increasingly involved in supporting Jews living illegally in Germany by providing housing, paying for living expenses and obtaining forged documents. Moreover, they tried to get in touch with Russian spies through foreign workers they recruited

beforehand. Their activities were discovered in September and they were sentenced to death by the people's court on 16 December 1943. Resistance begin: July 1943; Resistance end: September 1943.

Richard L., a commercial clerk participated in the illegal activities of the communist organization "National Committee for a Free Germany (NKFD)". He distributed pamphlets for the NKFD in and around Leipzig. From 1943 to 1944 he held political discussions with fellow communists based on the information he acquired through foreign sources (radio stations, other pamphlets). In May 1944 he hid Friedrich K., a communist sympathizer and SPD operative who was on the wanted list, for two weeks in his apartment. L. was found guilty by the people's court and sentenced to death on 24 November 1944.

Heinrich N., a former KPD member engaged with Soviet prisoners preparing a riot at the prison camp near Rodisfort. His occupation as a farmer and forestry worker allowed N. repeated contacts with Soviet soldiers who were forced to work in the fields. From 1942 to 1943 he spread news about the war at the Eastern Front among the prisoners which he gathered by listening to foreign radio stations. He was aware that the prisoners waited for the right opportunity to riot and promised them help. In November 1943 he was discovered storing guns, ammunition and maps. N. was sentenced to death by the people's court on 19 September 1944. Resistance begin: May 1943; Resistance end: November 1943.

Hans L., a secondary school teacher in Hamburg criticized the biased reporting of the German media in front of his students. The father of one of his students (a lieutenant in the German air force) reported him to the authorities for making defeatist statements between August and December 1943. The following statements were reported: "It's all nonsense what is reported in the news. I don't believe any of it." "Back when the Brits retreated it was a sign of defeat on their part. Now that Germany did it, it is called a victory." and "One thing is clear: Someone will win this war. The question is, who." Moreover, L. tried to persuade his students to quit the Hitler Youth. On 26 July 1944 the people's court sentenced him to four years in prison, where he died of poor health in February 1945.

The vicar **Valter H.** ran a circle dedicated to religious education in Hamburg which Carl G. (mechanic), Ludwig S.-G. (chapelmeister), Richard H. (clerk), Dietrich H. (teacher and corporal) and Werner W. (carpenter) were members of. H. was already known to the police: He received a warning in 1942 for sending religious pamphlets to soldiers at the Front. The focus of the meetings was religious and political matters, especially the amorality of the Hitler regime. At one such meeting in June 1944 S.-G. disclosed his disgust at the random attacks on London citizens which in his opinion were the work of the Anti-Christ and a sign that the

Last Judgment has come. In the wake of the Stauffenberg-assassination attempt H. commented on the failure as follows: "Who knows what plans God made for Hitler. Maybe, He doesn't want his death to be that pleasant.", while mimicking a dreadful pain. H. further explained that under the given circumstances an attack on the Fuhrer was justifiable before God. The circle members got arrested in October 1944.

Karl Z. (locksmith and caretaker) and **Emma H.** (accountant) were members in the communist group "Anti-Nazi German Popular Front (ADV)"¹. Alongside other members, they produced a total of twelve leaflets and two editions of the newspaper "The Alarm Clock." Foremost, they advocated for an end to the war and the fascist regime. In summer of 1943 the ADV started cooperating with the "Brotherly Union of Prisoners of War (BSW)."² The ADV provided members of the BSW with accommodations, food supplies, fake documents and weapons. The BSW consisted of escaped Soviet prisoners and former Red Army soldiers. Their prerogative was to destabilize Germany from the inside and to be ready to take up arms in case of riots or the approach of the Soviet Army. Shortly after the BSW was discovered by the Gestapo in late 1943, the majority of ADV members were arrested as well. Z. was the only detained member to survive the war due to pleading insanity. The rest of the ADV was sentenced to death by the people's court in winter of 1944.

Rudolf W. (driver) sheltered Erich V. in October 1944, knowing that the latter was a sought member of a communist organization that planned the violent overthrow of the fascist government. V. put W. in touch with other communist in Stettin and managed to recruit him for the cause. Since then W. took part in meetings where the attendees listened to foreign radio stations, talked about politics, discussed means to secure weapons and made fail-safe plans in case they were found out. In November W. fled his home after V. alerted him of the Gestapo's investigation into one of their acquaintances. Later, he was arrested by the police. He was sentenced to death by the people's court on 9 February 1945.

¹ Antinazistische Deutsche Volksfront (ADV).

² Bratskoje Sotrudnitschetswo Wojennoplennykh, BSW.

APPENDIX F: RADIO

Listeners in Germany

Figure F. 1: Numbers of radio subscriptions in Germany (approximate number of radio receivers) and the introduction of people's receiver

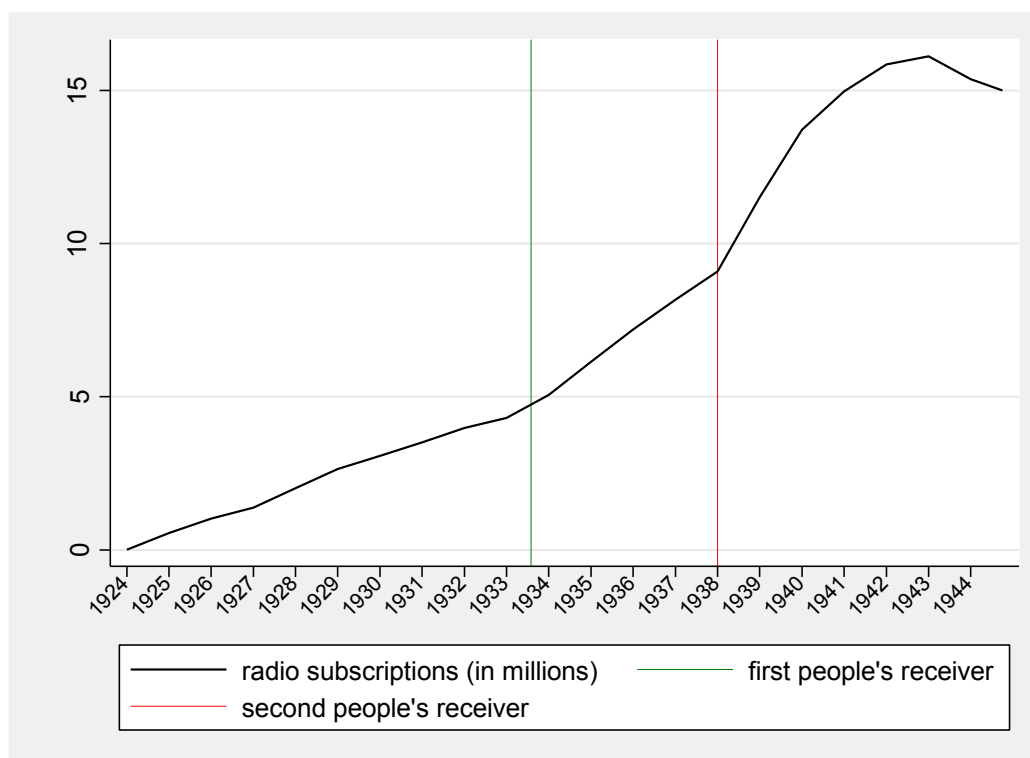


Table F.1. BBC German Service Broadcast details

GMT	
0400-0500	Workers' Programme
0900-0915	News
1200-1230	Miscellaneous
1300-1315	Miscellaneous
1400-1415	Aus der Freien Welt
1600-1615	Forces' Programme
1745-1800	Seamen's Programme
1800-1830	News and Commentary
2000-2020	News and Talks
2100-2115	Austrian Programme
0000-0015	News

Notes: Example: The Daily Schedule of the German Broadcasts in 1942; source: Briggs 1970, p. 430

Radio Listening – Anecdotal Evidence

*(wherever the German text precedes,
author's translation follows)*

To strengthen his broadcasting monopoly, Joseph Goebbels authorized the production of an inexpensive radio set, the “Volksempfänger” (“People’s Set”), which could tune in to regional stations via medium wave, and the national station, Deutschlandsender (Radio Germany), via long wave but which prevented listeners from receiving the short-wave transmissions issued by foreign broadcasters.

Vike Martina Plock (2020)

Mann also reminded Sherwood that she was “too familiar with the situation in Germany and German-occupied countries, as not to realize the futility of the short-wave enterprise” for which she had been commissioned to write. There “exist only five groups of people who possess short wave receivers” in Germany, she stated, a fact she had “repeatedly pointed out” (Mann to Sherwood, 1). These are “Nazi officials, big industrialists, air-men, navy-men, and radio-professionals,” and for that reason it seems “a hopeless enterprise” “to write short-wave-propaganda for the German middle classes” or “talk . . . to Germany’s women via short-wave” as these listeners owned the specially designed “Volksempfänger” (“People’s Set”), which could not receive programs on short-wave frequencies (1–2). To “devote one’s time and strength to the making of ‘propaganda’ which cannot be heard,” Mann concluded, “is sadder than to write poetry exclusively for one’s own drawers” (2).

Vike Martina Plock (2020)

Only the longer short-wave bands could be used effectively for transmission over relatively short distances and only a minority of listeners in Europe had short-wave receivers.

Pawley (1972) p.253

The NSDAP rulers’ fear of the subversive effect of enemy propaganda and their low confidence in their self-assertion can be seen from their commitment to interfere foreign broadcasting with technical measures. All radios were sold without receiver for short waves, which disabled to receive 95% of all foreign radio. For the People’s receiver VE301 and of the German small

receiver these technical constraints were already considered in their development and production from 1933 to 1935. These cheap devices were produced without a short wave receiver. The others who were under suspicion of a shortwave receiver were monitored (Putter, 1978, p.127). Thereby radio dealers should report people to the Gestapo, who buy such parts.

Wittek (1962) p.39

BBC foreign services in German was broadcasted using short, middle and long waves. However, Volksempfänger and Kleinempfänger (the later version of the popular radio) owned by the most of the population was technically not able to receive short wave broadcasting. The few individuals owning older and more expensive receivers allowing reception of short waves were under observation and those who purchased replacement parts to build such powerful receiver were to be reported to Gestapo.

Weidenhaupt (2001) p.56

The first black stations had been ostensibly run by secret resistance groups inside the countries at which they were directed. Anyone with an apparatus to locate the source of radio signals could quickly unmask the pretence but few of the intended audience were so equipped - even supposing that they had the short-wave sets needed to receive the programmes at all.

Balfour (1979) p.97

So great has become the influence of the BBC that the Germans gave orders that all sets in the large towns of the ' Protectorate' of Bohemia and Moravia must be brought in so that they might be made incapable of receiving short waves.

BBC (1944) p.77

BBC was the first broadcasting service and remained the only one for a long time, sending on medium wave and receivable anywhere in Germany.

Dussel (1999) p. 107

Wie groß bei den nationalsozialistischen Machthabern die Furcht vor der zersetzenden Wirkung ausländischer Rundfunkpropaganda war und wie wenig sie auf die Durchsetzungs- und Überzeugungskraft ihrer eigenen Gesetze vertrauten, zeigt die Tatsache, daß sie den Empfang ausländischer Sendungen auch technisch zu verhindern suchten. Schon die Entwicklung und die Produktion des Volksempfängers VE 301 186 und des Deutschen Kleinempfängers in den Jahren 1933 bzw. 1935 standen unter dieser Maßgabe. Bei diesen beiden Billiggeräten fehlte ein Empfangsteil für Kurzwellen, auf denen rund 95 Prozent der ausländischen Sendungen ausgestrahlt wurden.

Weidenhaupt (2001) p.56

How much the national socialist authorities feared the subvertive power of foreign broadcasting propaganda and how little trust they had in their own laws can be seen by their attempts to physically prevent the radio reception of foreign programs. Even the development and production of the Volksempfänger VE 301 186 and the Kleinempfänger in the years 1933 and 1935 was structured accordingly. Both low-priced devices were lacking a receiver capable to receive short-waves on which around 95 percent of the foreign programs were transmitted.

Weidenhaupt (2001) p.56

Großbritannien reagierte auf die deutschen Abschottungsbemühungen mit verschiedenen Gegenmaßnahmen. Hatte man bei Ausbruch des Krieges den Kurzwellenbereich wegen seiner hohen Reichweite und seines geringeren atmosphärischen Schwundes favorisiert und dem Europa-Dienst der BBC lediglich einen einzigen Mittelwellensender zugestanden, so installierte man im Verlauf des Krieges angesichts der fehlenden Kurzwellenteile in einem Großteil der deutschen Radios vermehrt, Mittel- und Langwellensendeanlagen.

Weidenhaupt (2001) p.56

Great Britain reacted to the German isolation attempts with various countermeasures. At the beginning of the war short-waves were favored because of the high range and low

atmospheric losses and the BBC was equipped with only one medium wave transmitter. But because most German radios were lacking short-wave receivers it was decided to install additional medium-wave and long-wave transmitters during the ongoing war.

Weidenhaupt (2001) p.56

Im Jahr 1943 verfügte der Europa-Dienst bereits neben 24 Kurzwellensendern über drei Mittelwellen- und einen Langwellensender. Die über Mittelwellen ausgestrahlten deutschsprachigen Sendungen der BBC waren lange Zeit die einzigen Sendungen, die von den leistungsschwachen Geräten in den deutschen Haushalten überhaupt empfangen werden konnten.

Weidenhaupt (2001) p.56-57

In 1943 the Europa-Dienst already had three medium-wave and one long-wave transmitters besides its 24 short-wave transmitters. The medium-wave transmitted German broadcasts of the BBC were for a long time the only programs that could be received by German households at all.

Weidenhaupt (2001) p.56-57

Den Höhepunkt bildete das Jahr 1943 mit wöchentlich mehr als 34 Stunden, die vor allem über Kurzwelle, abends und nachts aber auch mit Hilfe starker Mittel- und Langwellensender nach Deutschland gesendet wurden. Die Verwendung von größeren Wellenlängen sollte auch den vielen Deutschen, die über kein zum Kurzwellenempfang geeignetes Radiogerät verfügten, das Hören des Deutschen Dienstes ermöglichen.

Kaufmann (2013) p.42

The high point was reached in 1943 when over 34 hours of weekly broadcast was transmitted to Germany mainly via short-wave and at night via strong medium-wave and long-wave transmitters. Longer wavelengths were intended to facilitate listening to the German Service by the many Germans who didn't possess a radio that was capable to receive short-waves.

Kaufmann (2013) p.42

Die individuelle Einstellmöglichkeit der Rundfunkempfänger sollte dem Zwangsempfang weichen. [...] Zusätzlich wurde die Möglichkeit erörtert, neue Geräte grundsätzlich ohne Kurzwellenteil zu produzieren und in bereits vorhandenen die Kurzwellenteile stillzulegen oder auszubauen.

Klinger (1983) p.227

The individual setting possibility had to move for compulsory reception. Furthermore it was discussed to always produce the new devices without a short-wave receiver and to shut down or remove the short-wave receivers of the already existing radios.

Klinger (1983) p.227

Rund 95 Prozent dieser Programme und Sender wurden über Kurzwelle ausgestrahlt. Nun verfügte aber der "Deutsche Volksempfänger" vom Typ VE 301 GW, das in Deutschland am weitesten verbreitete Empfangsgerät, nur über einen Mittel- und Langwellenteil.

Pütter (1978) p.127

About 95 percent of the programs and channels were transmitted via short-waves. But the "Deutsche Volksempfänger" VE 301 GW which was the most widespread receiver in Germany did only have a medium-wave and long-wave device.

Pütter (1978) p.127

Da die Mehrzahl der Auslandssender ihre Programme über Kurzwellenfrequenzen ausstrahlte, für die das am meisten verbreitete Rundfunkgerät, der Volksempfänger, gar keinen Empfangsteil besaß, war der potentielle Hörerkreis von vornherein eingeschränkt.

Pütter (1986) p.11

Because most of the foreign channels transmitted their programs via short-waves for which the most widespread radios didn't have a suitable receiving device the potential audience was limited from the start.

Pütter (1986) p.11

Die deutschsprachigen Sendungen der BBC waren die ersten und lange Zeit über auch die einzigen Sendungen für das Reich, die über Mittelwelle ausgestrahlt wurden und leistungsstark genug waren, um den berühmten "Mann auf der Straße" überhaupt zu erreichen.

Pütter (1978) p.127

The German broadcast of the BBC was the first and for a long time the only program for the Reich which could be transmitted via medium-wave and which was strong enough to reach the famous "man in the street" in the first place.

Pütter (1978) p.127

Short-wave receivers were not very popular already before the Nazis came to power:

Die Fabrikation von Kurzwellengeräten, die z. B. in den Vereinigten Staaten von Amerika für den Inlandsmarkt und den Export (namentlich nach tropischen Gebieten) eine größere Rolle spielt, scheint in Deutschland nicht rentabel zu sein; denn ausgesprochene Kurzwellenempfänger wurden in der vergangenen Saison, von wenigen Ausnahmen abgesehen, nicht hergestellt.

Institut für Konjunkturforschung (1933) p.17-18

The production of short-wave devices which for example was very important for the United States of America in respect to its domestic market and export (namely to tropical regions)

seems to be uneconomical in Germany; that is because real short-wave receivers were—apart from a few exceptions—not produced in the last season.

Institut für Konjunkturforschung (1933) p.17-18

Ohne Zusatzgeräte konnten mit dem Volksempfänger nur nahe gelegene deutsche Sender empfangen werden, das Hören ausländischer Rundfunkprogramme, die über Kurzwelle gesendet wurden, war nicht möglich.

Benz (2008) p.50-51

Without additional devices the Volksempfänger was only able to receive nearby German channels, the listening to foreign radio channels which were transmitted via short-waves was not possible.

Benz (2008) p.50-51

Sources used in the Appendix F:

- ¶ Balfour, Michael (1979) Propaganda in War 1939—1945—Organisations, Policies and Publics in Britain and Germany. Routledge & Kegan Paul: London.
- ¶ Benz, Wolfgang (2008) Die 101 wichtigsten Fragen—Das Dritte Reich. Verlag C. H. Beck.
- ¶ British Broadcasting Corporation (1944) BBC Year Book 1944. The British Broadcasting Corporation: London
- ¶ Dussel, Konrad (1999) Deutsche Rundfunkgeschichte: eine Einführung. UKV: Konstanz. Institut für Konjunkturforschung (1933) Der Markt für Rundfunkgeräte in Deutschland—Das Angebot. Schriftenreihe des Verbandes der Funkindustrie e.V.
- ¶ Kaufmann, Johannes (2013) Rundfunkkrieg—Deutsche und britische Radiopropaganda im zweiten Weltkrieg. Diplomica Verlag GmbH: Hamburg.

- ¶ Klinger, Walter (1983) Nationalsozialistische Rundfunkpolitik 1942—1945: Organisation, Programm und die Hörer. Universität Mannheim.
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- ¶ Pütter, Conrad (1978) In den Wind gesprochen? Zur Wirkung des Deutschen Exilrundfunks zwischen 1933 und 1945. Studienkreis Rundfunk und Geschichte—Mitteilungen 4. Jahrgang Nr. 3. Rundfunk und Geschichte e.V.: Hannover/ Göttingen.
- ¶ Pütter, Conrad (1986) Rundfunk gegen das „Dritte Reich“—Deutschsprachige Rundfunkaktivitäten im Exil 1933—1945. Rundfunkstudien Band 3. K G Saur: München.
- ¶ Vike Martina Plock (2020) Erika Mann, the BBC German Service, and Foreign-Language Broadcasting during WWII. Modernism/modernity Print Plus Volume 5, Cycle 1. Johns Hopkins University Press
- ¶ Weidenhaupt, Heike (2001) Gegenpropaganda aus dem Exil—Thomas Manns Radioansprachen für deutsche Hörer 1940 bis 1945. Journalismus und Geschichte Bd. 5. UVK Verlagsgesellschaft: Konstanz.
- ¶ Wittek, Bernhard (1962) Der britische Ätherkrieg gegen das Dritte Reich—Die deutschsprachigen Kriegssendungen der British Broadcasting Corporation. Verlag C. J. Fahle GmbH : Münster.

APPENDIX G: DETAILED DATA SOURCES

High treason court cases:

1943-1945: Widerstand als "Hochverrat" 1933 - 1945 / hrsg. vom Institut für Zeitgeschichte, München

Data on BBC transmitters:

Martin Watkins' AMFREQS Spreadsheet: <http://www.mds975.co.uk/Content/AMFREQS.zip> (retrieved on 7. Nov 2016)

Data on listeners in Germany:

1 April 1940: Schaefer, Horst, Rundfunk Archiv. Rundfunk und Fernsehen in Wissenschaft und Praxis, Jan. 1941, vol 1, R. v. Decker's Verlag, p.71-77. („Die Verbreitung des Rundfunks im Deutschen Reich in den kleineren Verwaltungsbezirken am 1. April 1940“)

1 April 1939: Schaefer, Horst, Rundfunk Archiv. Rundfunk und Fernsehen in Wissenschaft und Praxis, Jan. 1940, vol. 13, R. v. Decker's Verlag, p.71-77. („Die Verbreitung des Rundfunks im Deutschen Reich in den kleineren Verwaltungsbezirken am 1. April 1939“)

Data on bombing:

Davis, Richard G., Bombing the European Axis Powers: : A Historical Digest Of The Combined Bomber Offensive, 1939-1945 Maxwell Air Force Base, Ala : Air University Press. 2006 (with CD-ROM)

Other district level data:

Data compiled by Adena et al. (2015), see data description in the original article

Data on transmitters in Germany including jamming transmitters:

1944: Möller, Bernd-Andreas (2009) Handbuch der Funksende- und empfangsstellen der Deutschen Reichspost. Funk-Verlag Hein.

Data on weather:

We received weather station data on daily cloud density, rain and wind strength in 1943-1945 from Kachelmann GmbH, kachelmannwetter.com. There were 146 weather stations but not all are active thorough the complete period under study. We use a spherical variogram for the interpolation (for implementation see: <https://cran.r-project.org/web/packages/gstat/>) and a grid with 50.000 cells. Cloud density, rain and wind strength are interpolated for a set of places that consists of all cities over 20,000 plus other places being bombed plus places of resistance (place of living or resistance act). For small places localized next to each other (or next to a larger city), a rule of thumb of 5 km (straight line) is used to merge them together (or to a larger city). For example Rheinhausen, Rheinhausen/Krupps, Duisburg/Rheinhausen, Friemersheim, Ruhrort, Meiderich are all merged with Duisburg. Places outside of German

empire

boundaries

(<https://web.archive.org/web/20170709100924/http://censusmosaic.org/data/historical-gis-files> based on: MPIDR [Max Planck Institute for Demographic Research] and CGG [Chair for Geodesy and Geoinformatics, University of Rostock] 2011: MPIDR Population History GIS Collection (partly based on Hubatsch and Klein 1975 ff.)—Rostock; Hubatsch, W. and T. Klein (eds.) 1975 ff.: Grundriß der deutschen Verwaltungsgeschichte—Marburg.) are dropped (especially relevant for the resistance sample). Also places outside of 120 km around the weather stations are dropped for reasons of reliability of the interpolation.

Berlin damage maps:

“Blue Book” (March 1945) from Imperial War Museum. Note that the data is pre-Red Army invasion and destruction thus reflects bombing damage. This is in contrast with the map from the Agency for Cartography of Berlin in 1945 (“Gebäudeschäden im Gebiet der Stadt Berlin, Stand 1945, Topographische Karte 1:25000,” Herausgeber: Hauptamt für Vermessung der Stadt Berlin).

Moral Division Survey:

Data is from the USSBS. The individual returns were located in the National Archives in Washington and digitized.

APPENDIX H: EFFECTIVE COMBAT RANGE

Actual combat conditions in WW II differed significantly from those for which the B-17 had been designed, the USAAF had expected, and manufacturers had incorporated in their design (Hastings 2013). We use the declassified design specification of the B-17 (figure F.1), which gives the plane's range and combat radius as a function of bomb load, height flown, and speed (Boeing 1949). Because of the strength of German fighter attacks and flack, the entire journey from crossing the Dutch coast to the German target would normally be flown at altitude, while the manufacturer had only expected a climb 30 minutes prior to the bomb run. Also, combat flying was markedly faster than expected. Operational data from the USAAF shows that B-17s flew both high and fast. They also required significant time to form up: bomber formations were often so large that the first planes had reached their targets inside in Germany when the last planes were just crossing the Dutch coast. Accounting for the effect of these factors on combat radius is not an exact science.

We use the manufacturer's model calculations for combat radius with the following assumptions: Boeing's model gives ranges by bomb load and airspeed. We use this table but modify it in two ways. The model calculations in the manufacturer's spec sheet give an average range on a basic mission of 873 nautical miles, or 1,617 km (line "COMBAT RANGE OR RADIUS", column I). With high altitude, this drops to 788 nm (column V), and with high speed, to 595 nm (IV). Since both were typically used simultaneously, we calculate effective range as the product of range ratios, 0.9 and 0.68, respectively. This implies $0.62 \times 873 \text{ nm} = 537$, or a combat radius of 995 km. From this we deduct 10 km due to the need to form up over England, giving an effective maximum combat range of 985 km.

This adjustment is derived from following example: Bomber airfields of the 8th USAAF had been developed all over East Anglia. The USAAF 8th manual on tactical development (figure F.2) gives the example of an attack on Berlin in March 1945. Bombers of the First Air Division, 379 Bombardment Group based in Kimbolton, Cambridgeshire near St. Neots, UK (just South-West of Huntingdon, on the map of figure A.1), first flew to Watton, Norfolk, then from Watton to Cromer, where they formed up for the attack on Berlin. Instead of the straight line distance to Berlin of 928 km, they had to fly 952 km on the way out, adding 24 km to the distance travelled on the leg "out". Since the forming up only happened on the way towards the target, but not on the return flight, the extra flying time during assembly translates

into a reduction of 12 km of effective combat radius. Since St. Neots is somewhat further West than the majority of East Anglia airfields (figure F.3), we settle on an average adjustment of 10km.¹

SERVICE

U N C L A S S I F I E D

Loading and Performance-Typical Mission

C O N D I T I O N S			B A S I C		M A X . B O M B H I G H S P E E D		H I G H A L T .		F E R R Y		S N 0 1 9 0 9 8 7 6 5 4 3 2 1 0 S N
			R A D I U S	R A N G E	R A D I U S	R A N G E	R A D I U S	R A N G E	R A D I U S	R A N G E	
			I	II	III	IV	V	VI			
TAKE-OFF WEIGHT	(lb)		67,860	67,860	67,864	67,860	67,860	64,975			
Fuel & Oil	(gal)		2570/148	2570/148	2104/148	2570/148	2570/148	3600/148			
Military Load	(lb)		10,000	10,000	12,800	10,000	10,000	None			
Total Ammunition	(rds/cal)		5970/.50	5970/.50	5970/.50	5970/.50	5970/.50	5970/.50			
Wing Loading	(lb/sq ft)		47.8	47.8	47.8	47.8	47.8	45.7			
Take-off Power Loading	(lb/bhp)	①	14.1	14.1	14.1	14.1	14.1	13.5			
Stall Speed-(power off)	(kn)		89.0	89.0	89.0	89.0	89.0	87.5			
TAKE-OFF DISTANCE SL	(ft)	④	3780	3780	3780	3780	3780	3350			
Ground Run (no wind)	(ft)		4925	4925	4925	4925	4925	4400			
To Clear 50 ft Obst	(ft)										
CLIMB FROM SL											
Rate of Climb at SL	(fpm)	③	630	630	630	630	630	700			
Time To 10,000 Feet	(min)	③	17.0	17.0	17.0	17.0	17.0	15.4			
Time To 25,000 Feet	(min)	③	61.0	61.0	61.0	61.0	61.0	49.0			
Service Ceiling (100 f.p.m.)	(ft)	③	28,250	28,250	28,250	28,250	28,250	29,900			
COMBAT RANGE or RADIUS	(n.mi)		873	1529	689	595	788	2624			
Avg. Cruising Speed	(kn)		171	156	172	214	182	154			
Total Mission Time	(hr)		10.45	9.97	8.25	5.81	8.88	17.21			
Cruising Altitude	(ft)		10,000	10,000	10,000	10,000	25,000	10,000			
COMBAT WEIGHT	(lb)		48,692	43,982	47,384	49,586	48,140	45,535			
Combat Altitude	(ft)		25,000	25,000	25,000	25,000	25,000	10,000			
SPEED											
Max Speed (combat alt)	(kn)	②	278	280	278	277	278	239			
Max Speed At 26,700 Ft	(kn)	②	282	285	283	282	282	284			
CLIMB											
Rate of Climb (combat alt)	(fpm)	②	1250	1515	1320	1210	1280	1930			
Rate of Climb at SL	(fpm)	②	1870	2140	1940	1820	1895	2045			
CEILING											
Combat Ceiling	(ft)	②	33,500	35,200	34,000	33,200	33,700	34,700			
Service Ceiling	(ft)	②	36,950	38,450	37,400	36,650	37,150	38,000			
Service Ceiling	(ft)	③	36,450	37,650	36,800	36,200	36,600	37,300			
LANDING WEIGHT SL	(lb)		43,214	43,982	43,070	43,214	43,214	45,535			
Ground Roll	(ft)	④	1265	1275	1250	1265	1265	1290			
From 50' Obst.	(ft)	④	2710	2740	2700	2740	2740	2770			

NOTES

- ① Take-off power
- ② Max power
- ③ Normal power
- ④ Take-off and landing distances are obtainable at sea level using normal technique.

For airport planning add 25% to distances shown.

- ⑤ Detailed descriptions of the RADIUS & RANGE missions are given on page 6.

CONDITIONS:

- (a) Performance basis: NACA standard conditions, no wind, single airplane
- (b) Fuel consumption used in computing RADIUS & RANGE is based on flight test data increased 5%.
- (c) Performance based on powers listed on page 6.

B-17G

U N C L A S S I F I E D

27 APRIL 1949

B-17G U N C L A S S I F I E D 27 APRIL 1949
Figure H.1: B-17 Performance Specifications and Range Information
Source: Boeing (1949)

¹ Some units of the First Air Division formed up as far away as Oxford; other diverted North over the Wash to avoid the risk of collision when assembling bomber streams.

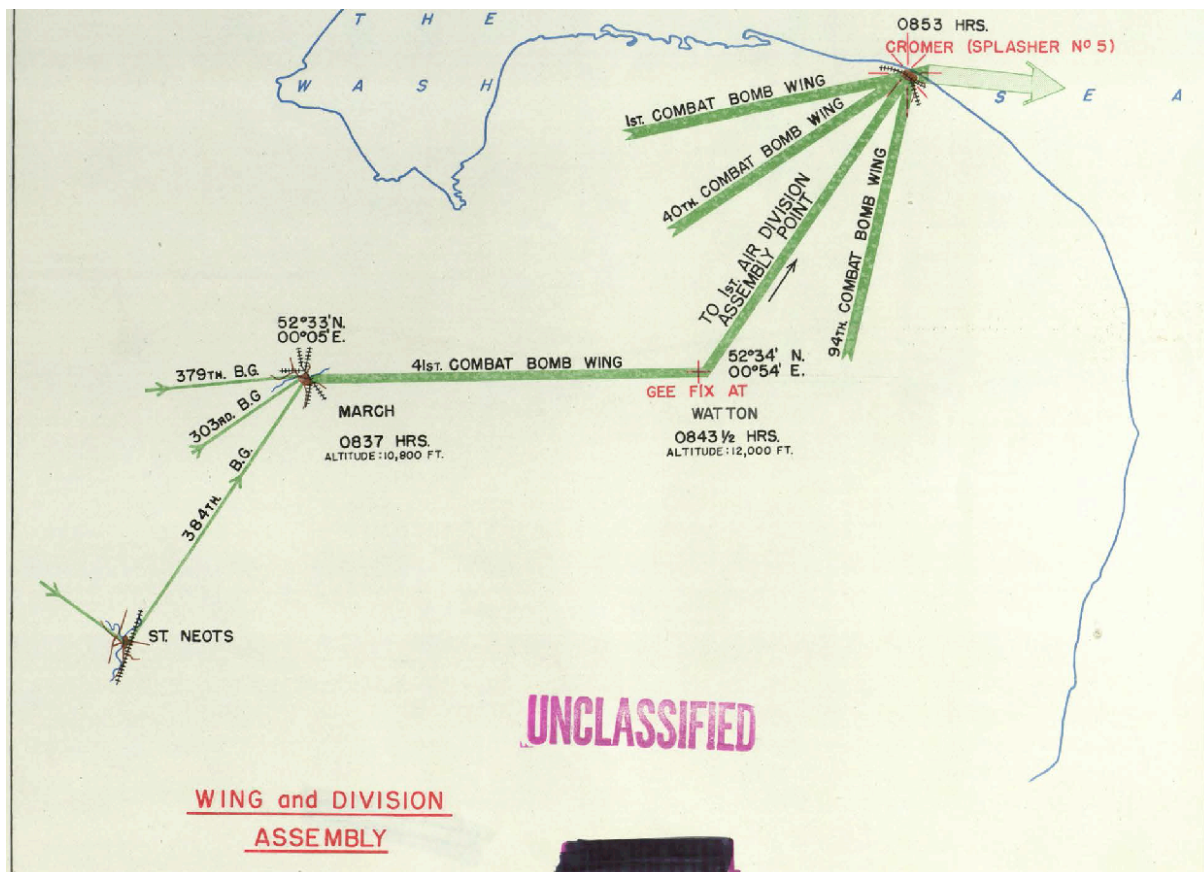


Figure H.2: Wing and division assembly, 8th USAAF
Source: USAAF (1945).

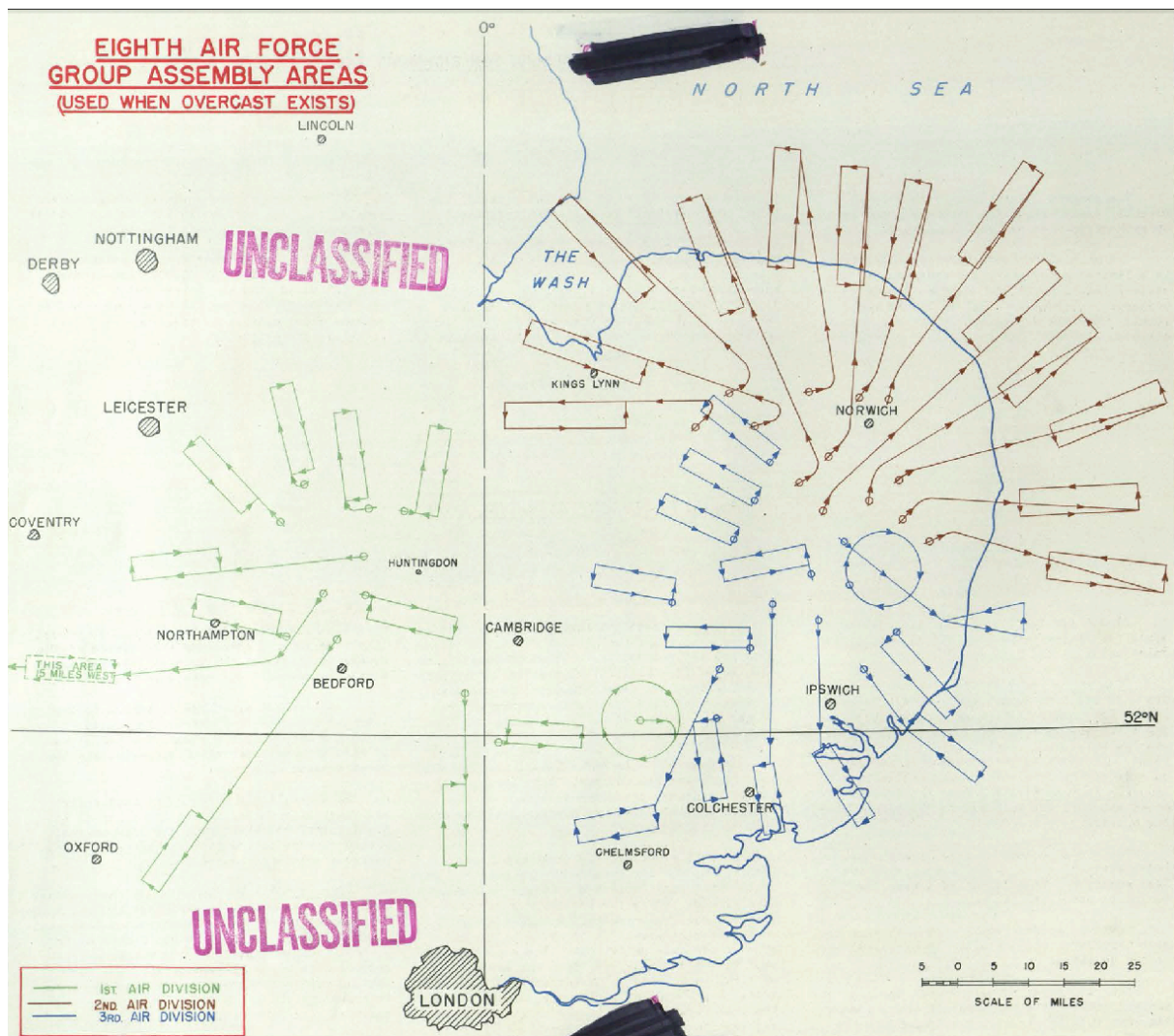


Figure H.3: Wing and division assembly, 8th USAAF

Source: USAAF (1945).

References:

Boeing (1949), *Standard Aircraft Characteristics*, Washington 1949.

Hastings, Max (2013), *Bomber Command*, London.

USAAF (1945), *8th USAAF-Tactical Development: August 1942-May 1945*, Washington 1945.